A Plantation Performance Assessment Guide for the Prince Rupert Forest Region

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A Plantation Performance Assessment Guide for the Prince Rupert Forest Region

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1 INTRODUCTION

The effort to assess plantation performance can be traced back to a 1974 meeting of reforestation officers in Surrey, B.C. At that time it was obvious that, although many foresters knew precisely how many seedlings they were planting, and at what cost, very few individuals had any idea of the success of those plantations several years later. Silviculturists could not objectively define the average height/age performance of local plantations, which in turn made it difficult to detect off-site plantations, or use yield tables designed for breast-height ages.

Since then a number of foresters have collected height versus age information from operational plantations in British Columbia. Most of these efforts, including the one reported here, have used methods developed by Hambly,[1] in which a minimum number of trees per strata were measured via stem nodes to produce total heights and annual height increments 4 or more years back in time. Vyse (1981) used a similar assessment to evaluate white spruce plantations in the Cariboo Forest Region. Draper discussed the limitations of these data, and made a number of recommendations for the use of height/age data that were used in the production of this field guide.[2]

This guide is the result of 3 years of field assessments in operational plantations. It summarizes a large amount of data and a number of regional documents. Further information can be obtained from the Silviculture Manual of the B.C. Ministry of Forests (1982), and the reports referenced in this text.

2 OBJECTIVES

With this guide a silviculturist may evaluate plantations in the Prince Rupert Forest Region to:

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1 E.S.L. Hambly. 1978. Plantation performance assessment. E.P. 784.02 Final Report. B.C. Min. For., Res. Branch, Victoria, B.C. Unpubl. rep.

2 D. Draper. 1983. Plantation growth performance analysis in the northern interior. E.P. 938. Final Report. B.C. Min. For., Res. Branch, Victoria, B.C. Unpubl. rep.

1. compare the total height, or height increment performance, of a particular plantation, to the mean performance of plantations in the local area;
2. determine whether the performance of that plantation is deteriorating or improving when compared to the mean;
3. determine the effects of various height/age and height increment/age "free-growing" guidelines on the acceptance and rejection of operational plantations in the local area.

It is important to note that this guide does not set height/age or height increment/age "free-growing" standards, nor does it constitute a legally required survey at this time. It does, however, provide information that should assist silviculturists in defining objective goals for plantation performance.

3 DEVELOPMENT OF THE GUIDE

3.1 Field Methods

A standard method of assessment and a computer-format field form were developed by research and silviculture personnel in 1981 (Appendix 1). Between 1981 and 1983, plantation surveys were conducted by regional and district staff throughout the Prince Rupert Forest Region. Plantations were selected on the basis of three criteria:

1. Survival rates exceeded 50%.
2. Plantations were not suppressed by competing vegetation.
3. At least 50% of each plantation was free from biotic and abiotic damage.

When a plantation met these conditions, it was stratified into uniform areas on the basis of stock type, seedlot, and ecological association. Transects were used to evenly distribute 50-m^2 plots throughout the stratum, and the nodes of 50 trees per stratum were measured with height poles to obtain total height/age relationships for the previous 6 years of growth. Only well-spaced trees were measured within

the plots. Trees that would obviously fail to become crop trees (e.g. severely suppressed, stunted, deformed, or damaged trees) were not measured.

Table 1 summarizes the regional assessment program of 332 plantations. Users should keep in mind that failed and brush-encroached plantations were omitted from the data base. Accordingly, these data represent the mean crop tree performance of successful plantations. Further growth improvements can be expected via vegetation management, site amelioration, and better site-species selection.

3.2 Limitations of the Method

Once the surveys were completed in each subzone or variant, Silviculture Section staff compared height/age relationships among common stock types and associations within the SBSe, CWHf, and ICHg subzones.[3-8] Few dramatic differences in performance could be detected among these categories. The absence of major differences is explained in

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[3] A. Middleburg. 1982. Standard growth curves for lodgepole pine (Pinus contorta) var. latifolia Engelm.) in the sub-boreal spruce zone - subalpine fir subzone in the Prince Rupert Forest Region. B.C. Min. For., Silv. Section, Smithers, B.C. Unpubl. rep.

[4] P. Chalifour. 1983. Performance of hybrid spruce and lodgepole pine within the ICHg subzone in the Prince Rupert Forest Region. B.C. Min. For., Silv. Section, Smithers, B.C. Unpubl. rep.

[5] B. Wesleyson. 1983a. Sitka spruce plantation performance in the CWHgl variant of the Queen Charlotte Island TSA. B.C. Min. For., Silv. Section, Smithers, B.C. Unpubl. rep.

[6] _____ 1983b. Interior spruce performance within the SBSe subzone. B.C. Min. For., Silv. Section, Smithers, B.C. Unpubl. rep.

[7] _____ 1983c. Sitka spruce plantation performance in the CWHfl variant of the Kalum TSA. B.C. Min. For., Silv. Section, Smithers, B.C. Unpubl. rep.

[8] _____ 1983d. Report on plantations measured for r.p.a.'s within the CWHfl variant of the Kalum T.S.A. B.C. Min. For., Silv. Section, Smithers, B.C. Unpubl. rep.

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TABLE 1. Plantation performance assessment program summarized by subzone, species, and year

Subzone	Species	Year survey completed	Number of plantations analyzed
CWHf	Sitka spruce	1982	54
CWHg	Sitka spruce	1983	27
ICHg	hybrid spruce (Sitka x white)	1983	52
ICHg	lodgepole pine	1983	24
SBSe	interior spruce	1982	90
SBSe	lodgepole pine	1982	85
Total			332

a detailed analysis of Walsh's field work.[9] Draper's statistical examination of this Prince George data set found several major problems with the regeneration performance assessment (r.p.a.) system.[10] Two of these problems affect the Prince Rupert Forest Region data, and hence influenced the analytical procedures used to produce this guide.

The first problem is related with the process of backdating nodes to obtain former total height/age information from single sample trees. Theoretically, if all nodes could be accurately identified, it would be possible to obtain a series of precise height/age data pairs for a single tree from its current total height back to the point of germination. Draper, however, found that errors in backdating were common because of lammas growth, and these errors were additive. The result is a gradual increase in the coefficients of variation as backdating progresses. There is no solution to this problem other than the use of stem analysis, and he recommended a limit of four growing seasons for backdating in interior spruce and lodgepole pine. This study found similar increases in the coefficient of variations such that it was decided not to accept any backdating further than five growing seasons.

The second major problem with plantation performance surveys concerns the great differences among various factors in plantations. Operational plantations are established with a vast number of different seedlots, site preparation techniques, climatic conditions at the time of planting, stock handling and storage conditions, vegetative competition, stock morphology, and root growth capacity, as well as simply stock type and site class

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9 S.J. Walsh. 1980. Height growth of spruce, pine and fir plantations in the Prince George Forest Region. Part 1: Range District 15; Part 2: West Lake P.S.Y.U., Prince George West District; Part 3: Willow and Purden P.S.Y.U.'s, Prince George East District. B.C. Min. For., Prince George, B.C. Unpubl. reports.

10 D. Draper. 1983. Plantation growth performance analysis in the northern interior. E.P. 938 Final Report. B.C. Min. For., Res. Branch, Victoria, B.C. Unpubl. rep.

differences. Thus, when one averages plantation performance by stock class (for example), there are many other uncontrolled factors that increase the experimental error such that actual stock type differences are masked by the variation added from these other factors. Also, during assessment, many of these factors are classed as either present or absent, when in fact the biological effectiveness of the treatment will depend upon a more detailed measure of its intensity. Prescribed fire is a good example of a treatment in which simple "burned" or "unburned" categories cannot capture the range of the effect.

In summary, it is important to realize that these stock type and site class differences often do exist, and they are frequently found in controlled experiments, although they usually remain hidden in surveys of operational plantations. The same limitations discussed by Draper were found in the Prince Rupert surveys. At this time there is no justification to subdivide the data to produce height/age summaries for different stock types or site classes. The data, for the most part, do not exhibit major or consistent differences among these factors.

3.3 Analysis

The limitations of the survey data restricted this analysis to the total height and the five most recent nodes per sample tree. Plantation height/age and height increment/age summaries were created on the Statistical Analysis System (SAS) for the 50 sample trees per strata. These summary data were pooled using SAS to produce the final height/age and height increment/age means for use in the appropriate diagrams. Programs for these analyses are attached as Appendix 2.

When plots of individual plantations were examined, few plantations were found to have curves with slopes identical to the mean curves. Many of the previously discussed silvicultural factors that prevent the development of more specific height/age comparisons evidently influence the early growth of individual plantations for some time. Partly for this reason, and partly to meet the requirements for a simple field method to evaluate operational plantations, it was decided not to produce height/age

curves, but rather to create a diagram that allows the forester to compare, at a given age, the performance of one plantation to the mean. Figure 1 illustrates a height/age diagram for interior spruce in the SBSe. The vertical bar on the sixth growing season has both right- and left-hand numbers. The left-hand numbers, from top to bottom, give the maximum (134 cm), average (64 cm), and minimum (38 cm) mean plantation heights for that subzone. The right-hand numbers give the relative percentage of any single plantation when it is compared with the mean plantation height of 64 cm. Thus, a plantation that has an average height of 100 cm at 6 years, has a performance rating of 156%. Prior to a discussion of the use of these diagrams, the method by which one acquires field data from a single plantation will be summarized.

Users of these diagrams should be aware that connecting the means will not produce a smooth height/age curve in all cases. Because curve-fitting techniques were not used, small sample sizes at the extremes of the diagrams will occasionally cause irregularities in the height/age or height increment/age curves. Also, climatic variation has influenced the height increment/age diagrams to an unknown degree. Thus, some fluctuations in the general trend should be expected should one attempt to produce curves from these data.

4 THE FIELD SURVEY

Section 4.7 of the B.C. Ministry of Forests Silviculture Manual (1982) discusses the methodology for regeneration performance assessment surveys, which can be summarized as follows:

4.1 Stratification

The plantation can be surveyed as a single stratum if it is homogeneous. If major differences in topography, aspect, and site quality (i.e., ecological factors) exist, or if various stock types, seedlots, or site preparation methods were used (i.e., technical reasons), the plantation should be broken into separate, homogeneous strata, and each surveyed as a separate unit.

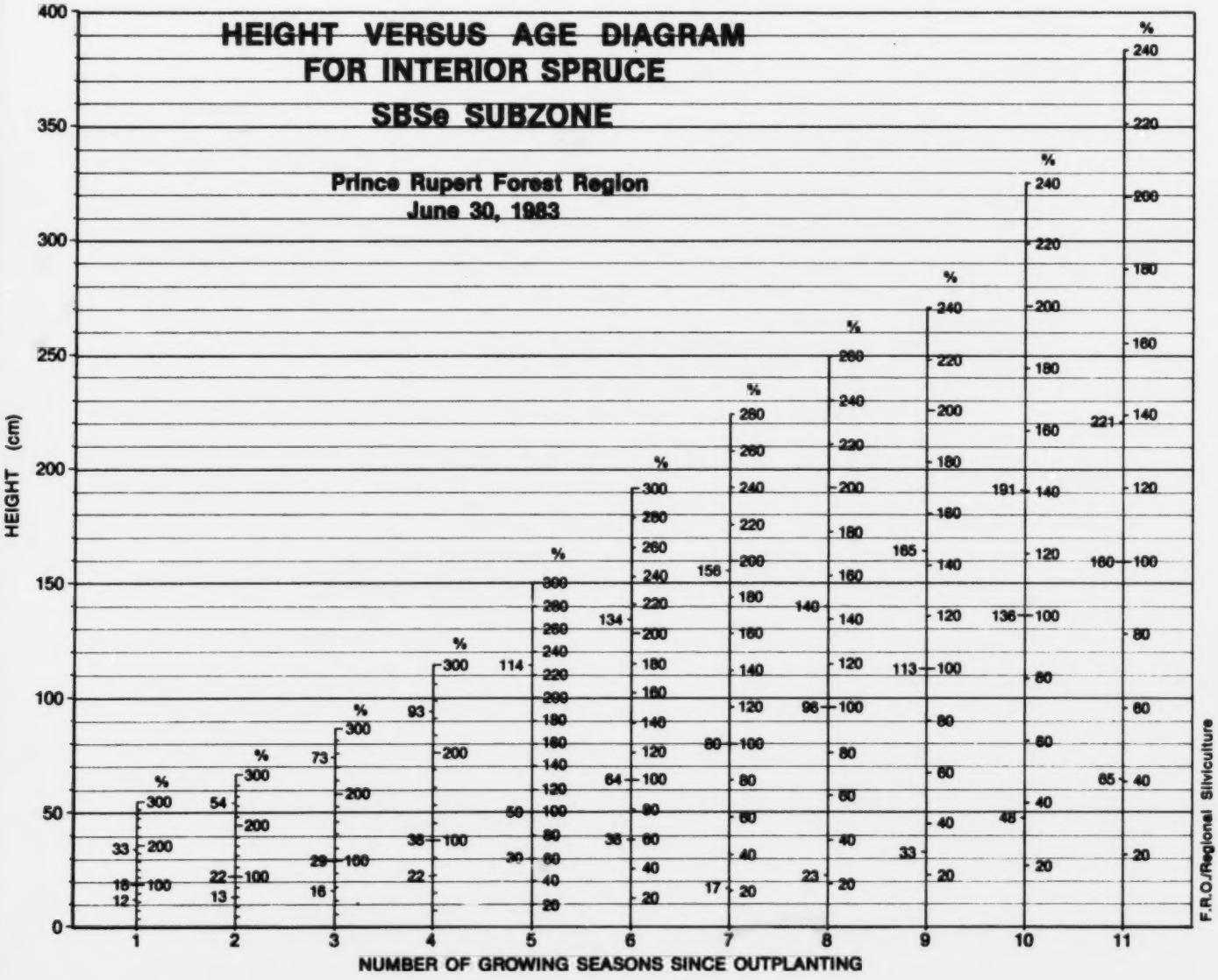

FIGURE 1. Height versus age diagram for interior spruce in the SBSe: single point evaluation.

4.2 Sample Lines and Plot Locations

Within each plantation, sample lines are laid out in a systematic manner parallel to one another. The lines cut across strata boundaries. Plots consist of temporary 50-m^2 (r = 3.99 m) circular plots. The interplot distance is calculated based upon the required number of sample trees, the expected average number of sample trees per plot, and the length of the sample line within each stratum.

4.3 Sample Trees and Sample Sizes

Sample trees consist of all well-spaced trees, which are likely to become crop trees within each plot. Trees suffering from abiotic or biotic damage should not be tallied. Depending upon the objectives of the survey, either planted, natural, or advanced regeneration may be tallied provided each is identified and the minimum sample size for each category in each stratum is met.

This report recommends a minimum of 40 sample trees per species per stratum for reconnaissance level surveys, and 50 sample trees per species per stratum for surveys intended to acquire standard height/age information for the construction of local guides.

4.4 Field Measurements and Records

For non-nodal species, only the total height and age can be tallied for each tree. Assessments should be performed either in the spring or the fall when the leaders of the sample trees are not actively growing.

For nodal species, the total height and heights of each node up to the fifth node are tallied. Any current leader growth is ignored if active growth is under way (Figure 2).

This report recommends that only the total height and the heights of each node up to the third node be tallied for reconnaissance surveys, and this be increased up to the fifth node for surveys intended to produce guidelines.

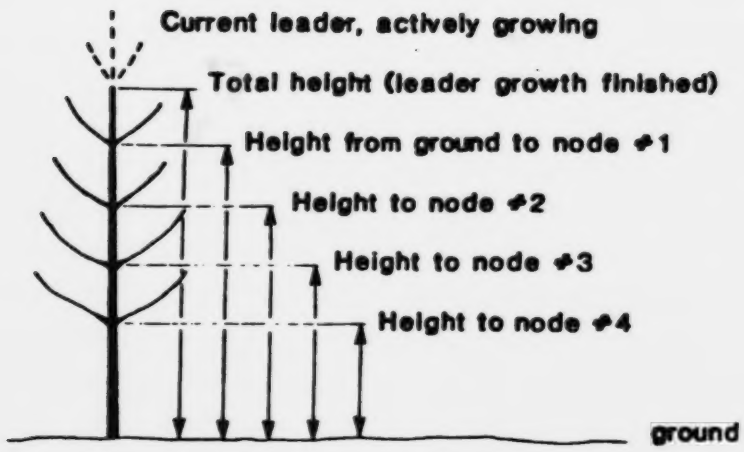
Current leader, actively growing
Total height (leader growth finished)
Height from ground to node #1
Height to node #2
Height to node #3
Height to node #4
ground

FIGURE 2. Total heights and node heights for a nodal species.

Reconnaissance level survey data are recorded on FS 788-A. A manual calculation form (FS 788-B) and a stratum summary form (FS 788-C) are useful. Those foresters who are engaged in the production of standards may wish, when faced with hundreds of plantations, to use the computerized field forms and SAS analysis programs described in Appendices 1 and 2. Although the tally form allows individual tree ages to be coded for natural and advanced regeneration, do not use the Appendix 2 SAS programs to analyse these data. These programs are designed for plantations, and some modifications are required before natural or advance regeneration performance analyses can be made.

5 THE DIAGRAMS AND FREQUENCY TABLES

In the following three sections diagrams and tables are presented that summarize the early plantation growth of commercial tree species in the Prince Rupert Forest Region. Sections 5.1 and 5.2 discuss the height/age and height increment/age diagrams, with explanation of their use. Section 5.3 discusses the frequency tables that demonstrate the effect of various height/age and height increment/age guidelines on the percentage of surveyed plantations failing to exceed those guidelines.

5.1 Height/Age and Height Increment/Age Diagrams: Single Point Evaluation

When a survey has been made in a plantation, the forester may examine the performance of the plantation using either the height/age diagrams (Figures 5-10) or the height increment/age diagrams (Figures 11-16). In either case, the survey field data are reduced to averages and plotted on the appropriate diagrams. For example, an interior spruce plantation was 90 cm tall after seven growing seasons in the field. The seventh season bar in Figure 1 is read on the left-hand side at "90" to yield a right-hand reading of "113". Thus, the trees in this plantation are 13% taller than the species mean for the subzone. The forester may also have a height increment of 20 cm for this plantation which, when used in

Figure 3, yields a rating of 114%. These performance ratings show that the plantation is not only taller than the mean for the area, but its current annual height increment is greater than the mean.

The forester may also calculate the performance rating for a plantation simply by dividing the individual plantation mean by the diagram mean for the subzone, and multiplying by 100. Thus, for the height/age performance rating of the 90-cm tall plantation at 7 years, the appropriate calculation would be

$$PR = \frac{90}{80} \times 100 = 113\%.$$

5.2 Height/Age and Height Increment/Age Diagrams: Trend Evaluation

The use of performance ratings in Section 5.1 allows the forester to evaluate the development of a plantation of a nodal species over time. For example, with the use of nodal heights from a plantation survey, plantation mean heights of 90 cm at 7 years, 65 cm at 6 years, 45 cm at 5 years, and 30 cm at 4 years can be calculated. Figure 4 illustrates the trend of these total heights when they are plotted against the height/age diagram. This plantation was below average at 4 years, equalled the mean performance of the subzone at 6 years, and had above-average growth at 7 years.

5.3 Height/Age and Height Increment/Age Frequency Tables

Although the mean height or height/age performance of an individual plantation may alert the forester to inferior or superior growth, the subzone variation in plantation means is incompletely described by the minimum and maximum values on the height/age and height increment/age diagrams. Partly for this reason, and partly to illustrate the need to set realistic performance guidelines for plantations, a series of frequency tables was developed for height/age (Tables 3-8) and height increment/age (Tables 9-14) data.

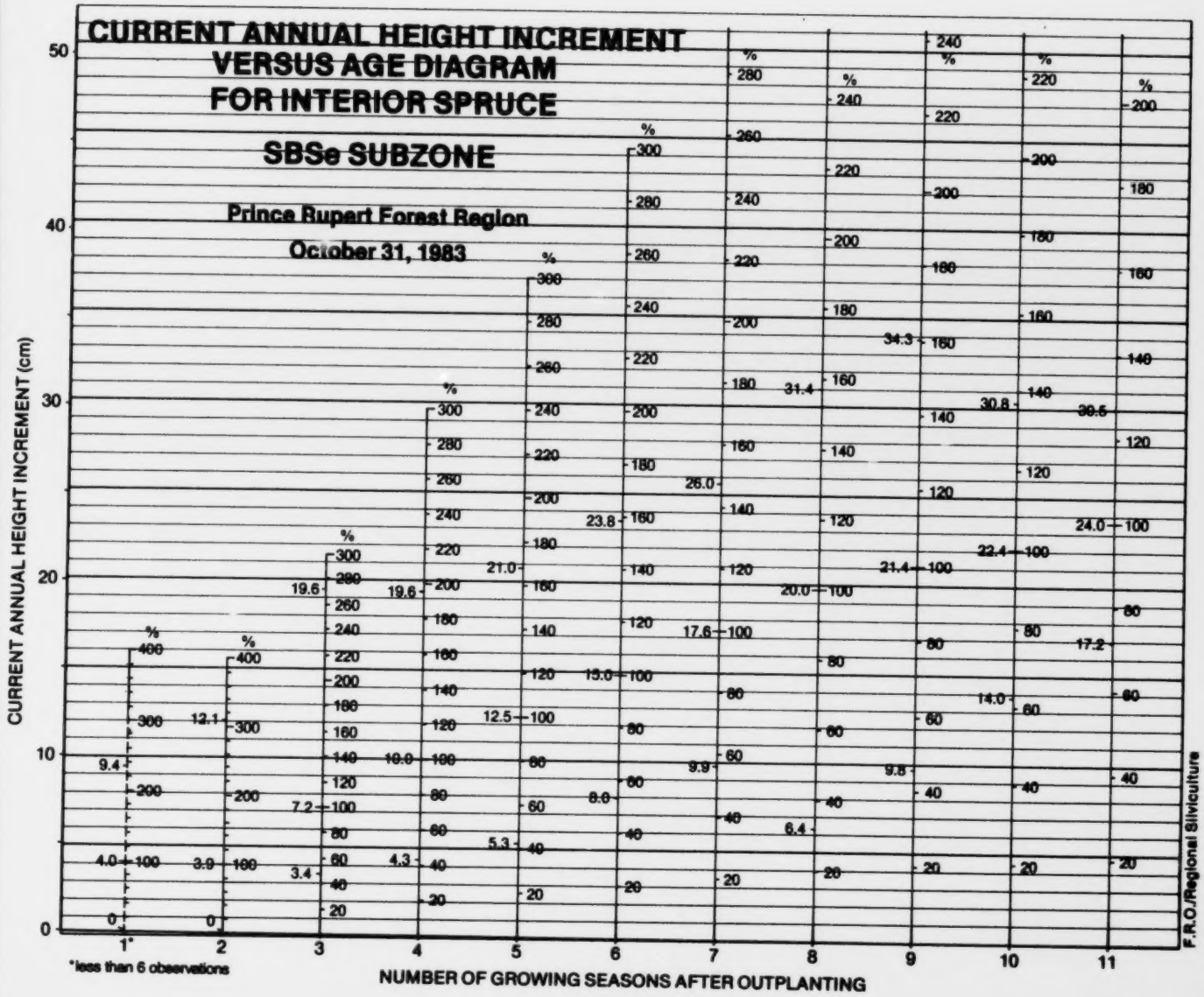
CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR INTERIOR SPRUCE
SBSe SUBZONE
Prince Rupert Forest Region
October 31, 1983
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS AFTER OUTPLANTING
*less than 6 observations
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FIGURE 3. Height increment versus age diagram for interior spruce in the SBSe: single point evaluation.

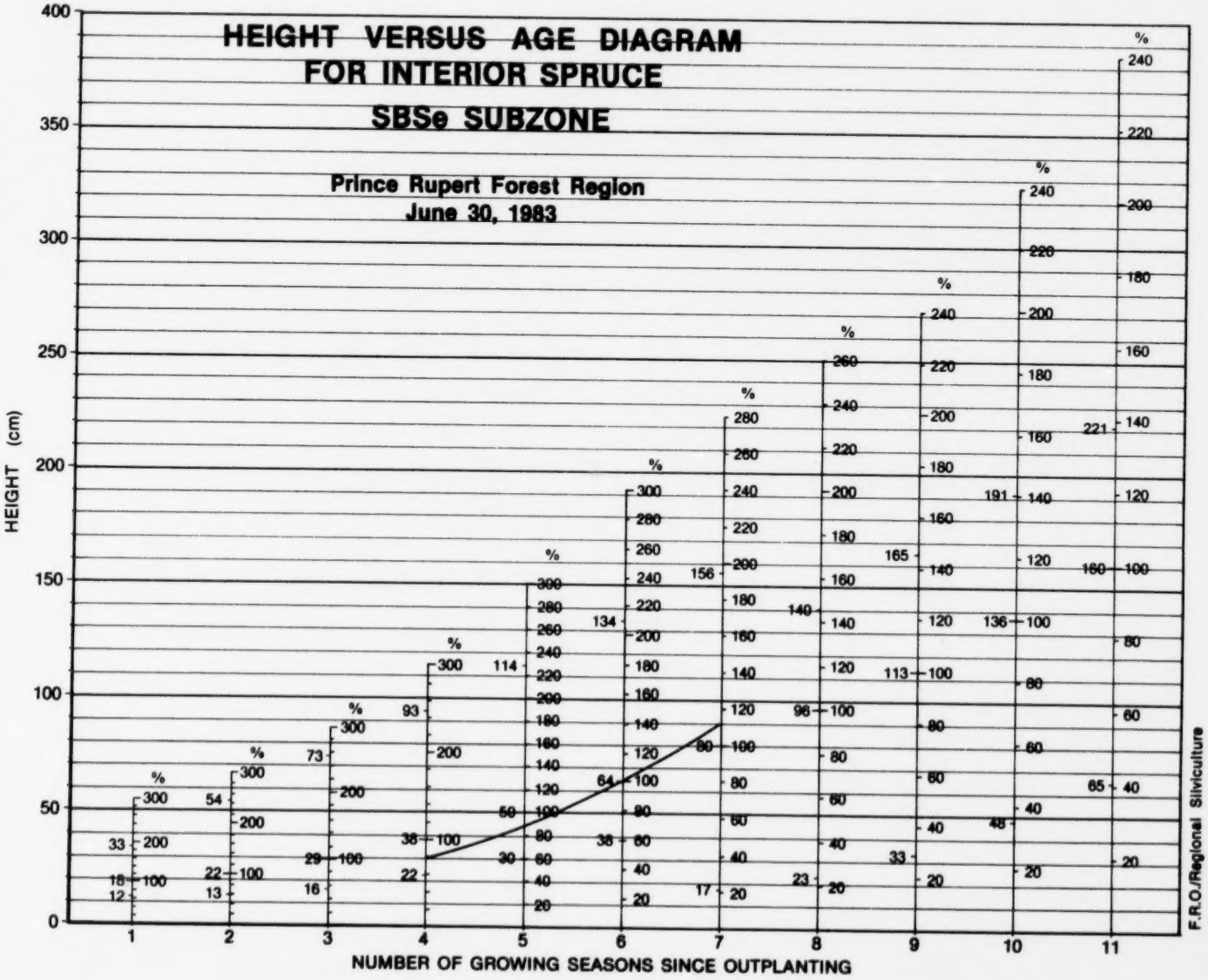


FIGURE 4. Height versus age diagram for interior spruce in the SBSe: trend evaluation.

Table 2 illustrates the use of such a table. The rows represent the years after outplanting, and the columns represent the height or height increment mean. For example, in an interior spruce plantation with a mean height of 90 cm at 6 years in the SBSe, locate the appropriate cell in the table by reading 90 across the top and 6 along the left-hand side. The information in that cell indicates that 96% of all surveyed plantations were less than 90 cm tall at 6 years and only 4% plantations were taller.

These tables can be used in another manner. The same information could be used to examine the effect of setting a height performance minimum of 90 cm at 6 years of age. In such a case, it could be expected that 96% of operational interior spruce plantations in the SBSe fail such a guideline, and 4% exceed it.

In this manner, the forester can examine the effect of various "free-growing" guidelines on his operational plantations. To date, the authors of this report know of no other objective method to determine the effect of various height/age and height increment/age guidelines.

5.4 Comments on the Use of this Guide

This guide is a basic tool for the evaluation of reforestation efforts in the Prince Rupert Forest Region. It is by no means complete, as information on natural and advance regeneration has not been obtained, and in several cases sample sizes are restricted. Furthermore, these surveys are not a mandatory requirement although Tables 3-14 could be used to set "Free-growing" guidelines and evaluate one aspect of reforestation performance.

It is strongly recommended that foresters using this manual and performing plantation assessments adhere to the provincial sampling methodology and forms described in Section 4.7 of the Silviculture Manual, and submit the results of their surveys to the Silviculture Branch. In this manner, the data base can gradually expand so that more refined diagrams and tables can be produced.

TABLE 2. Cumulative percentages of interior spruce plantations in the SBSe that fail to meet various height guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height guideline of:																					
		10 (cm)	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230
1	34	0	76	100%																				
2	54	0	46	93	94	98	100%																	
3	63	0	5	71	94	95	98	98	100%															
4	71	0	0	13	75	92	96	97	99	99	100%													
5	73	0	0	1	14	62	85	94	96	97	99	100%												
6	75	0	0	0	1	11	41	73	85	96	99	99	99	100%										
7	49	0	2	2	2	4	8	20	57	78	88	90	98	98	98	98	100%							
8	32	0	0	3	3	3	3	6	9	28	66	84	91	94	100%									
9	26	0	0	0	4	4	4	4	12	19	23	31	69	85	85	88	92	100%						
10	18	0	0	0	0	6	6	6	6	6	17	22	22	28	67	72	78	83	83	89	100%			
11	16	0	0	0	0	0	0	6	6	6	6	6	12	25	25	25	50	62	75	81	81	88	88	100%

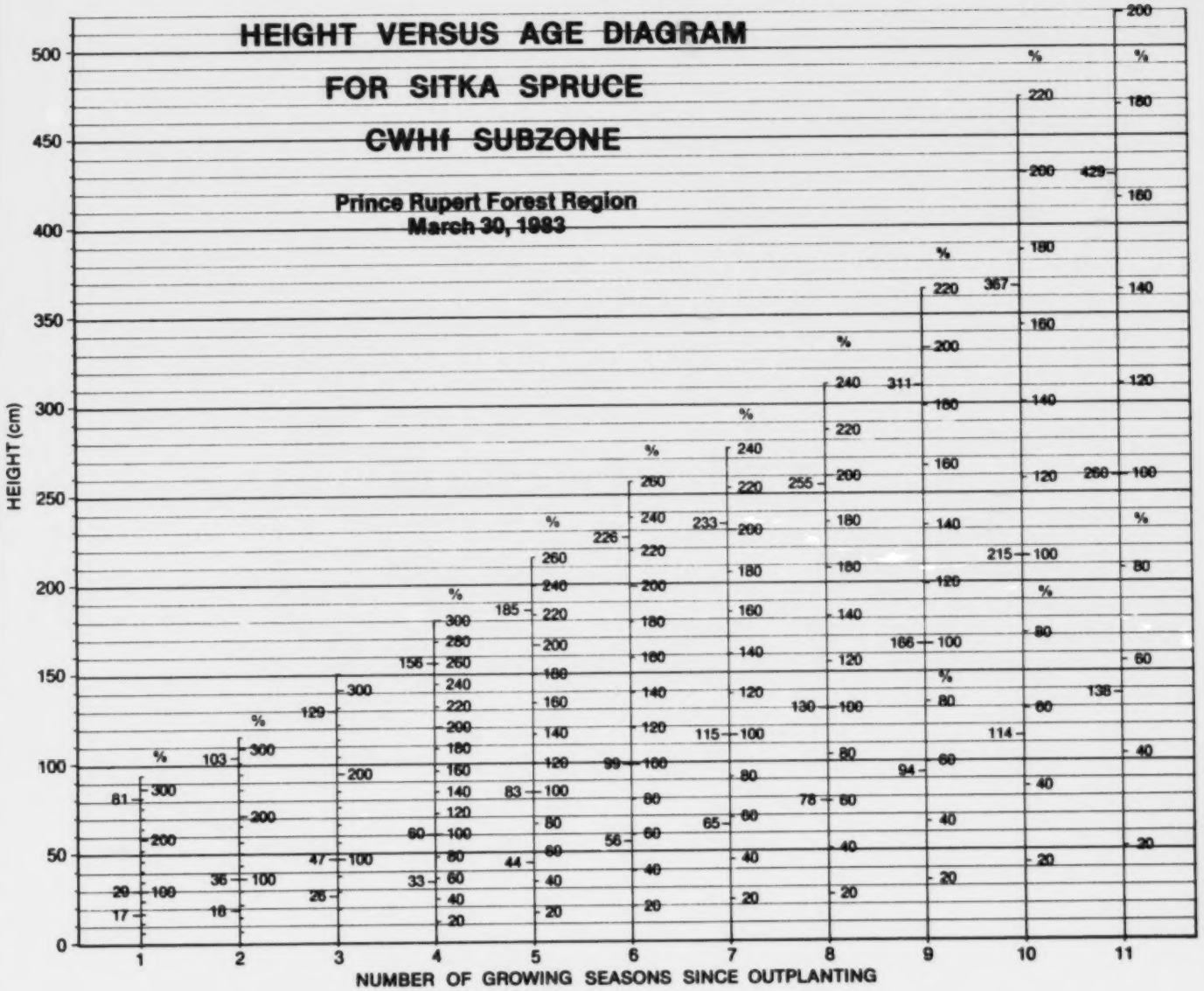


FIGURE 5. Height versus age diagram for Sitka spruce in the CWHf subzone.

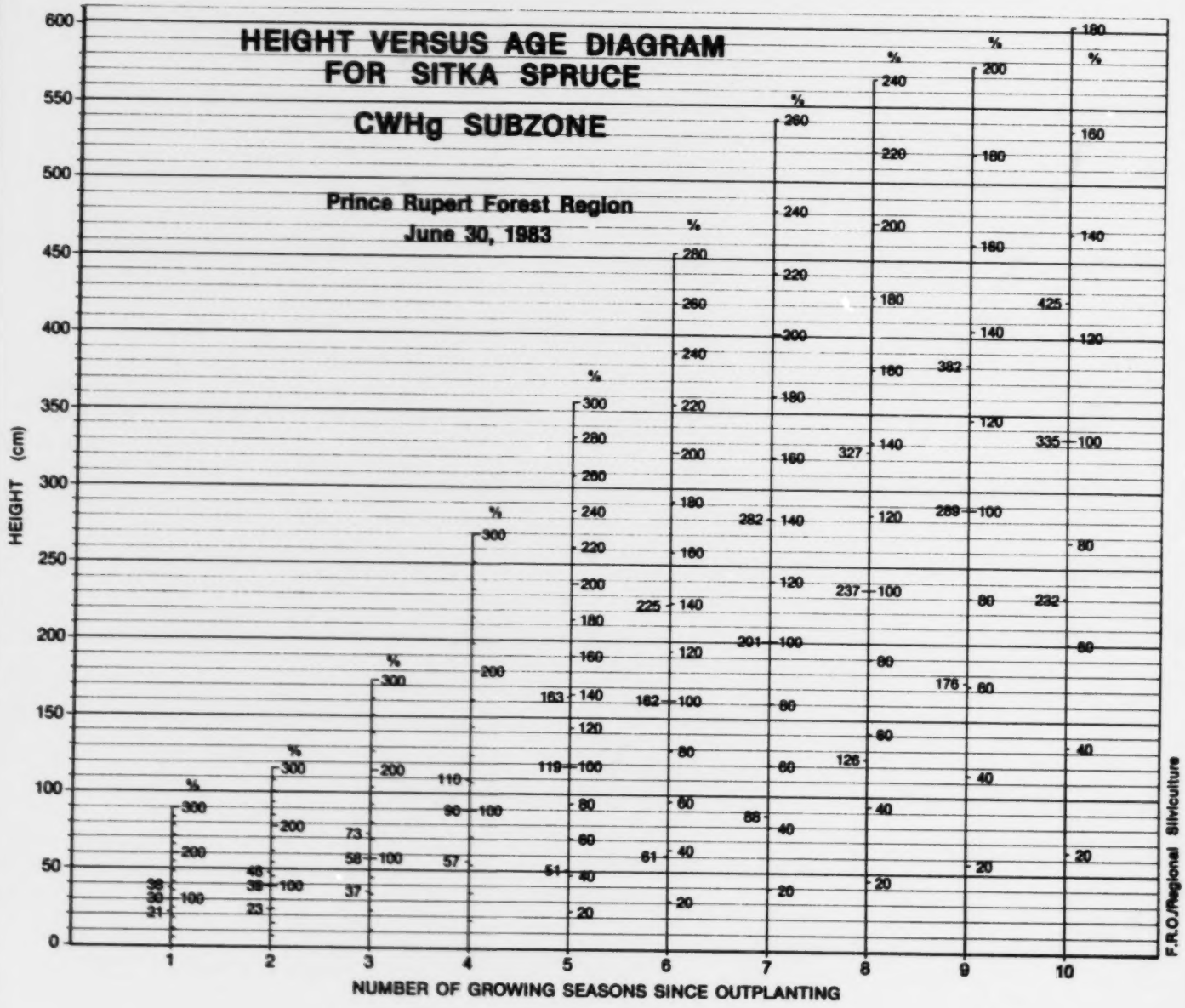


FIGURE 6. Height versus age diagram for Sitka spruce in the CWHg subzone.

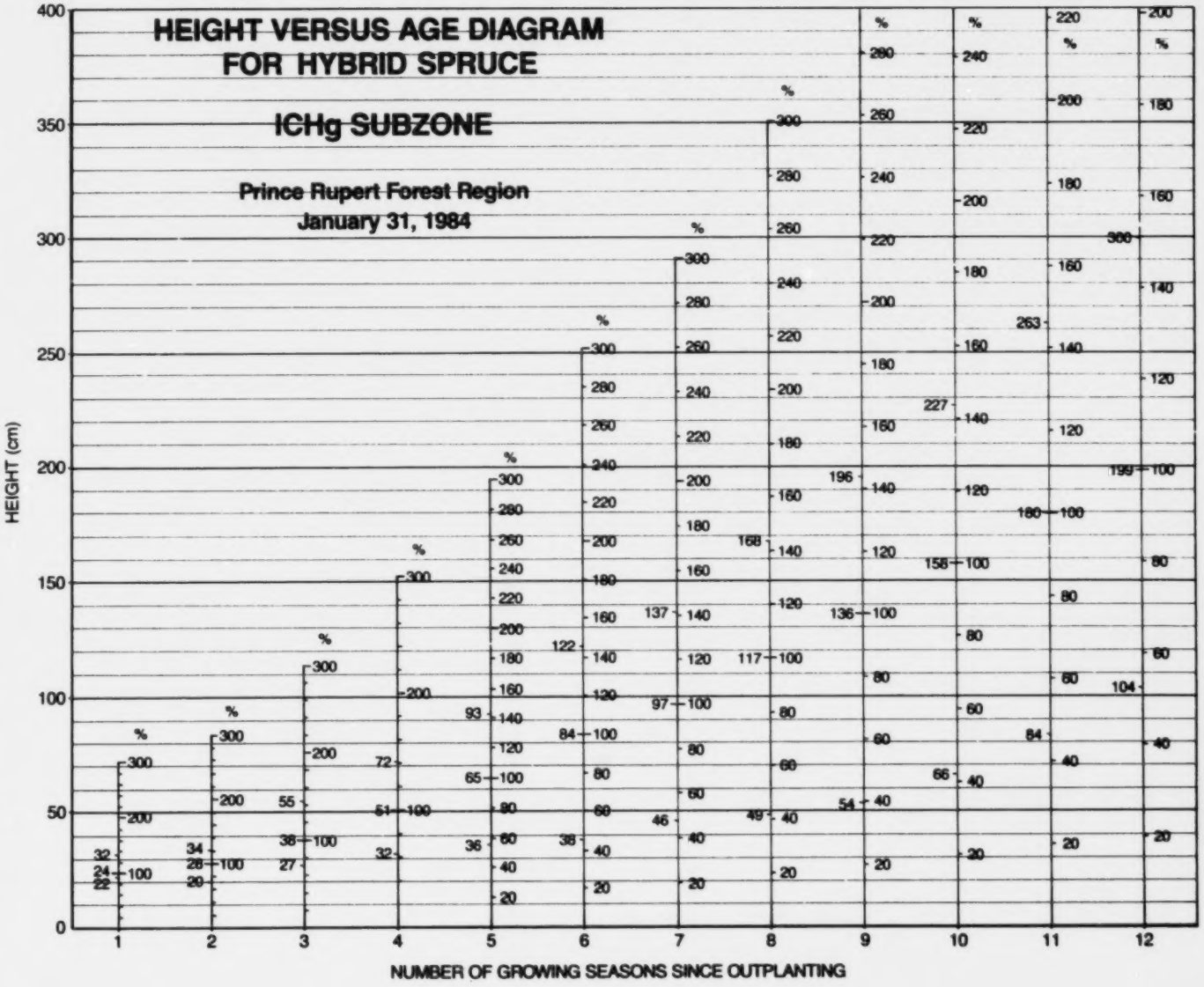


FIGURE 7. Height versus age diagram for hybrid spruce in the ICHg subzone.

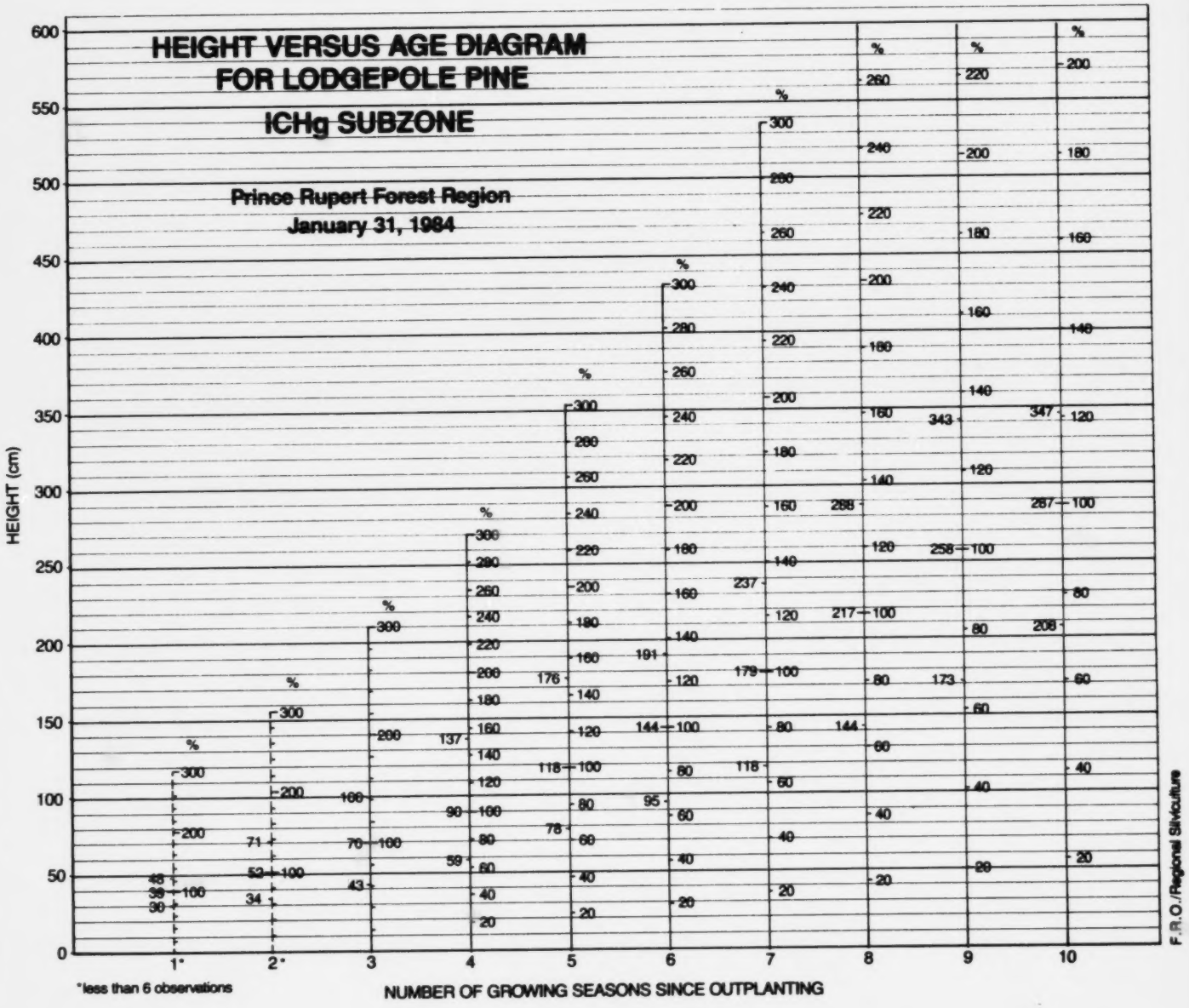


FIGURE 8. Height versus age diagram for lodgepole pine in the ICHg subzone.

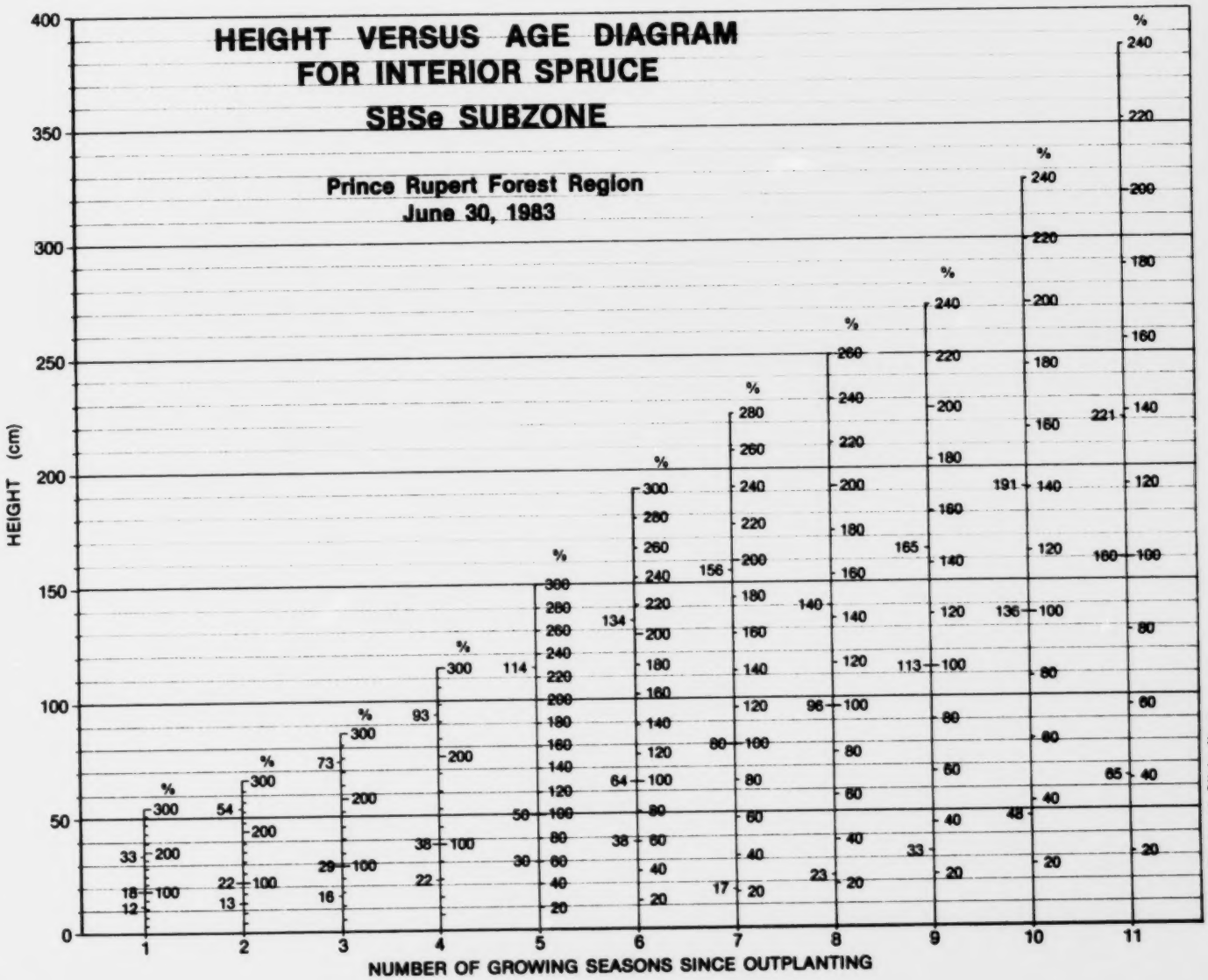


FIGURE 9. Height versus age diagram for interior spruce in the SBSe subzone.

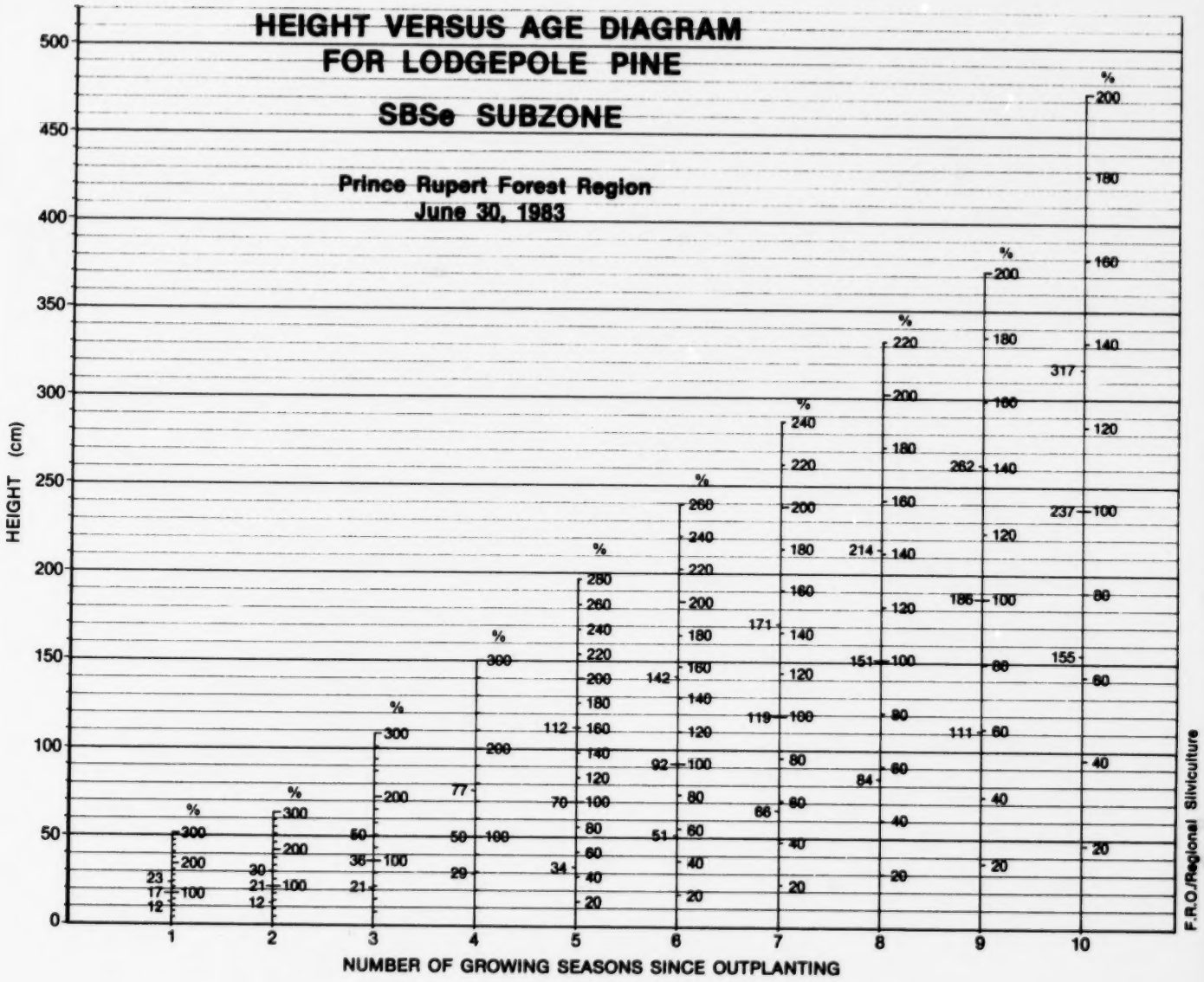


FIGURE 10. Height versus age diagram for lodgepole pine in the SBSe subzone.

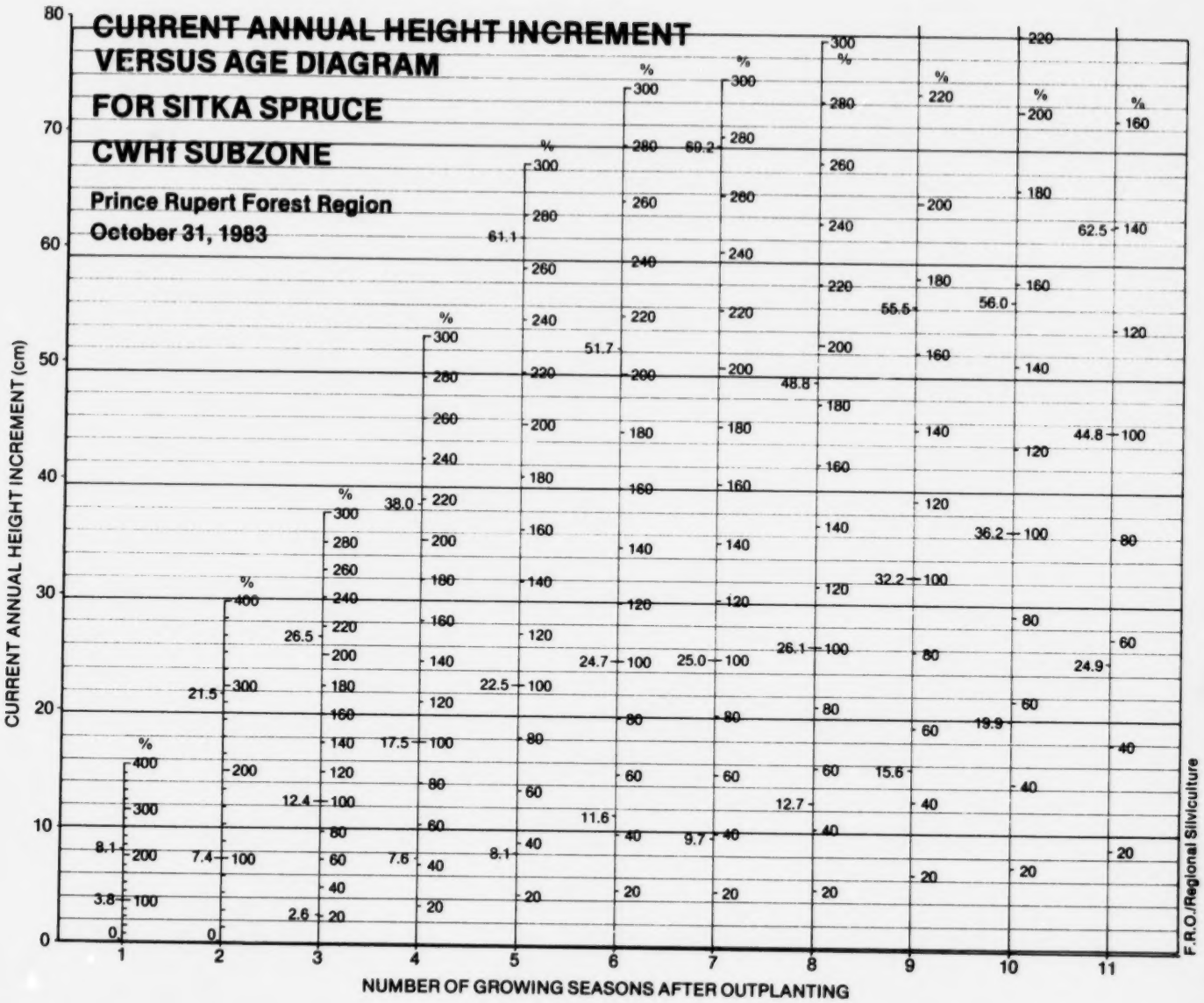

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR SITKA SPRUCE CWHf SUBZONE
Prince Rupert Forest Region
October 31, 1983
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS AFTER OUTPLANTING
F.R.O./Regional Silviculture

FIGURE 11. Current annual height increment versus age diagram for Sitka spruce in the CWHf subzone.

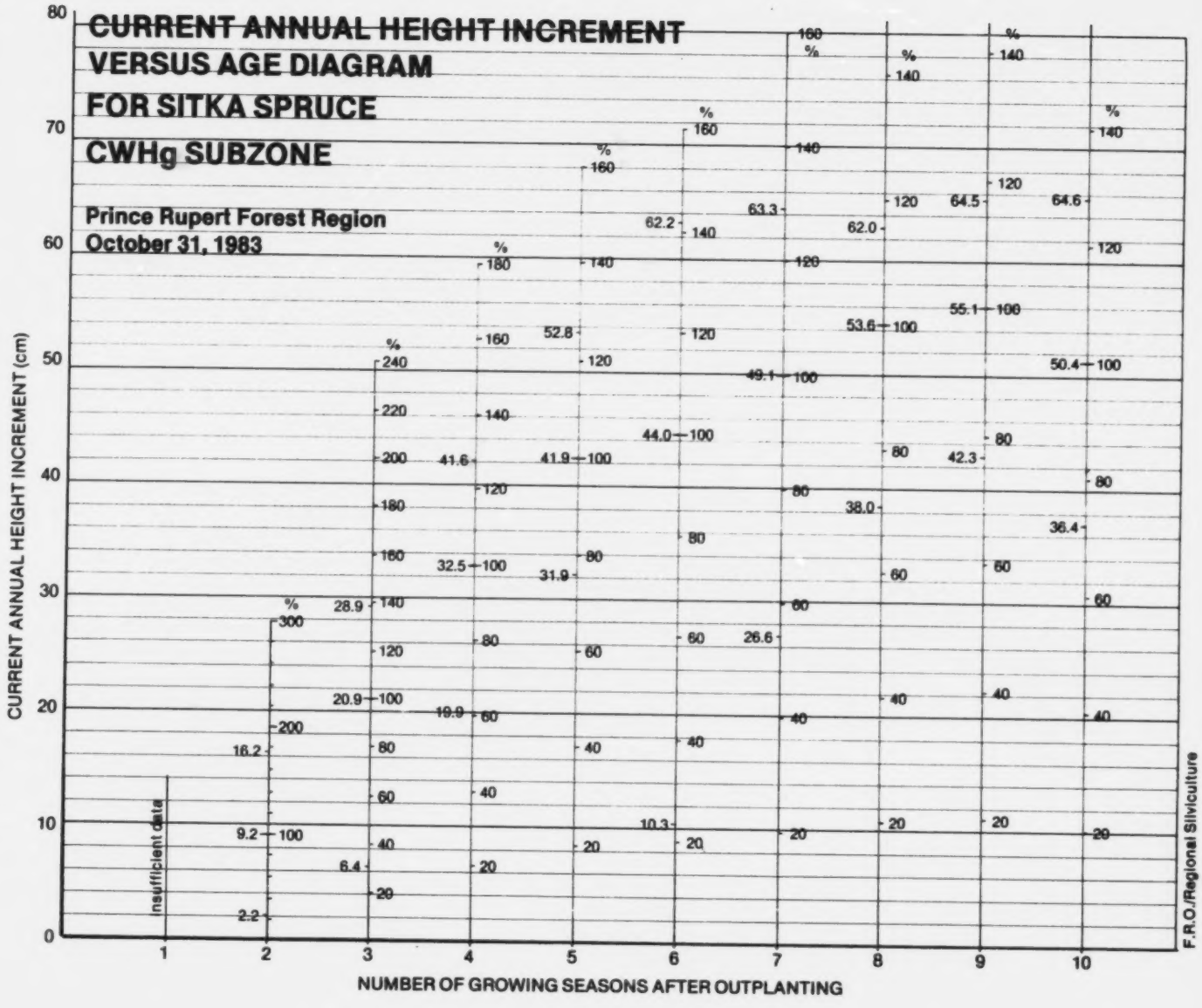

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR SITKA SPRUCE CWHg SUBZONE
Prince Rupert Forest Region
October 31, 1983
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS AFTER OUTPLANTING
Insufficient data
F.R.O./Regional Silviculture

FIGURE 12. Current annual height increment versus age diagram for Sitka spruce in the CWHg subzone.

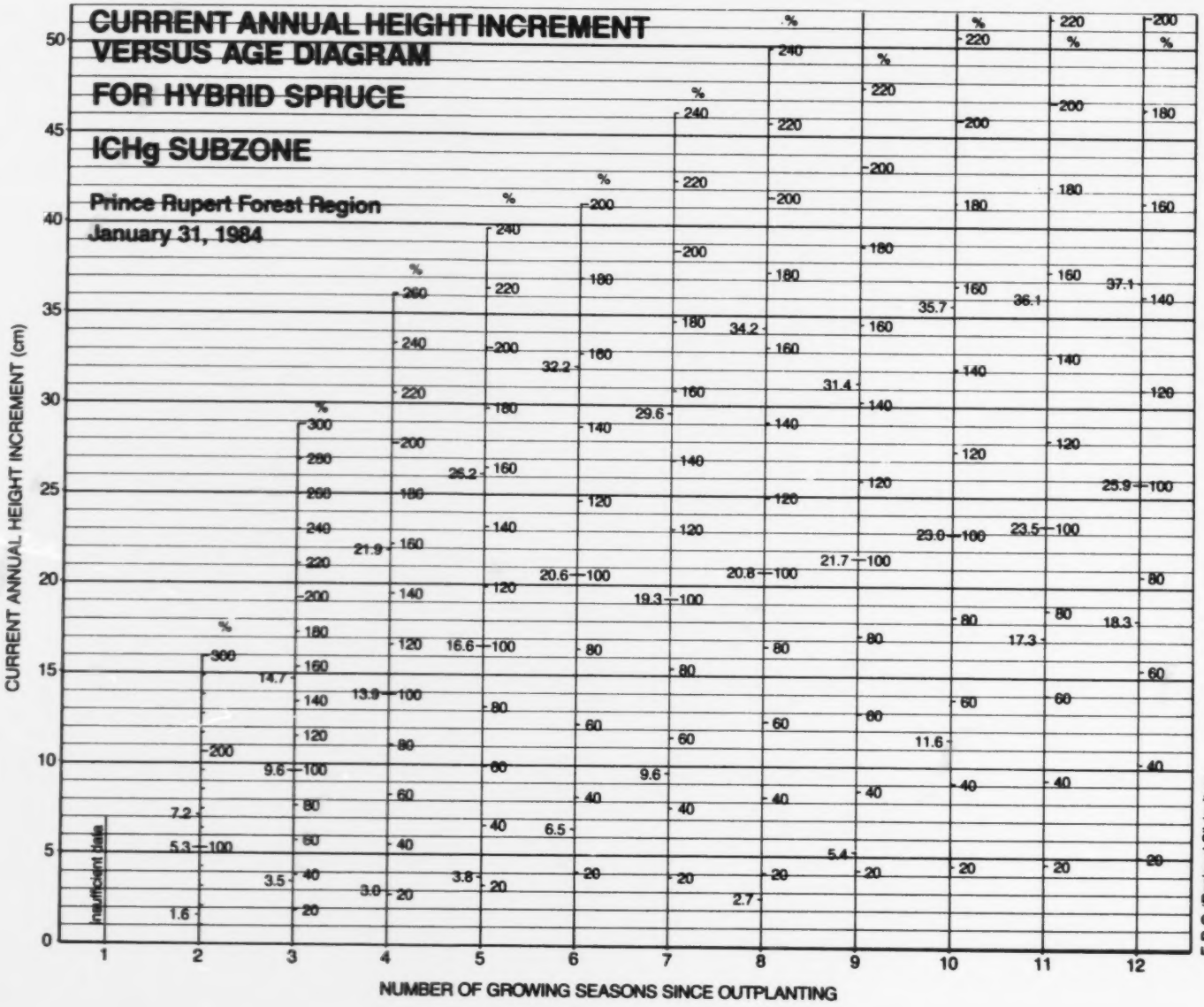

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR HYBRID SPRUCE ICHg SUBZONE
Prince Rupert Forest Region
January 31, 1984
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
insufficient data
F.R.O./Regional Silviculture

FIGURE 13. Current annual height increment versus age diagram for hybrid spruce in the ICHg subzone.

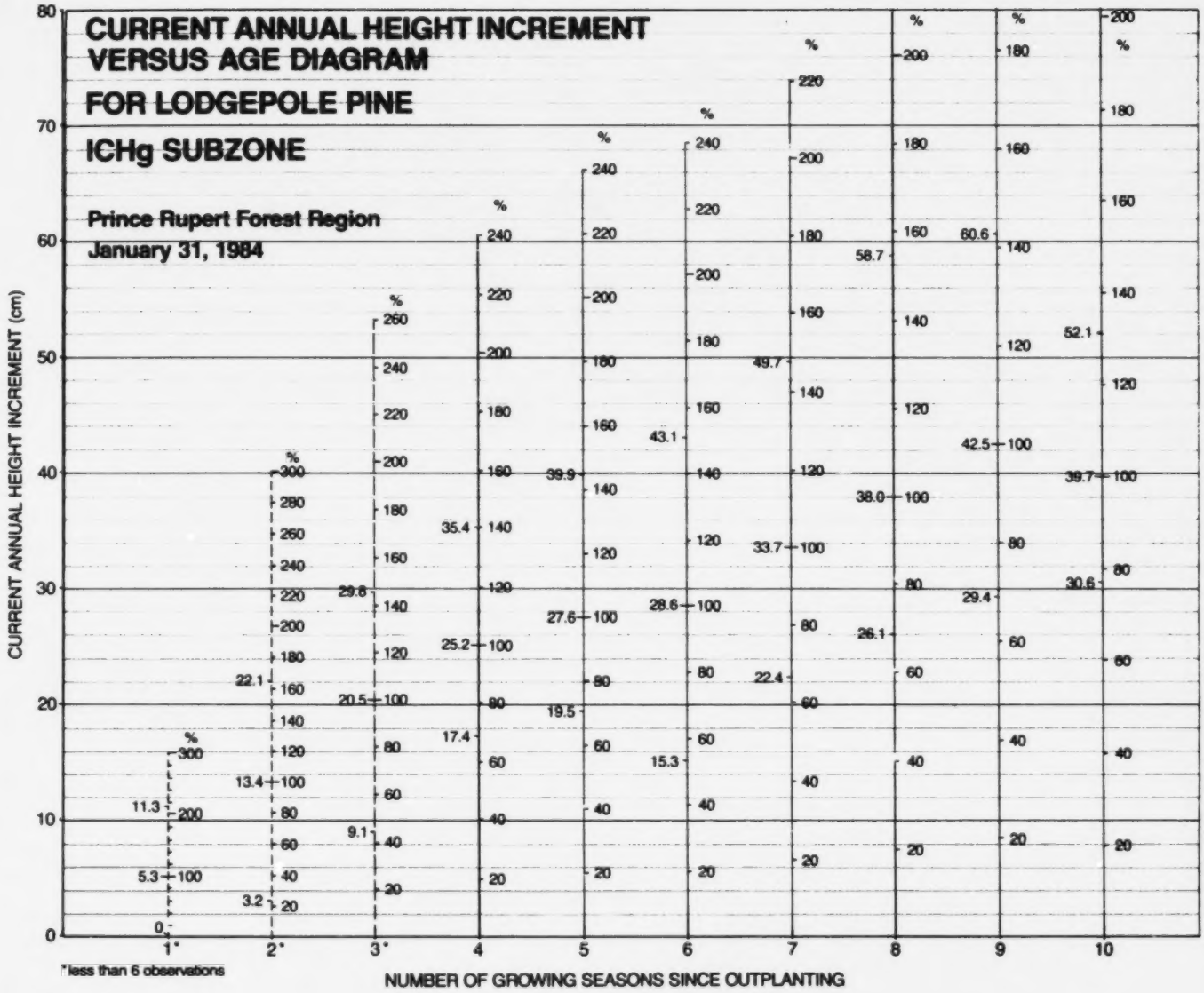

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM
FOR LODGEPOLE PINE
ICHg SUBZONE
Prince Rupert Forest Region
January 31, 1984
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
*less than 6 observations
F.R.O./Regional Silviculture

FIGURE 14. Current annual height increment versus age diagram for lodgepole pine in the ICHg subzone.

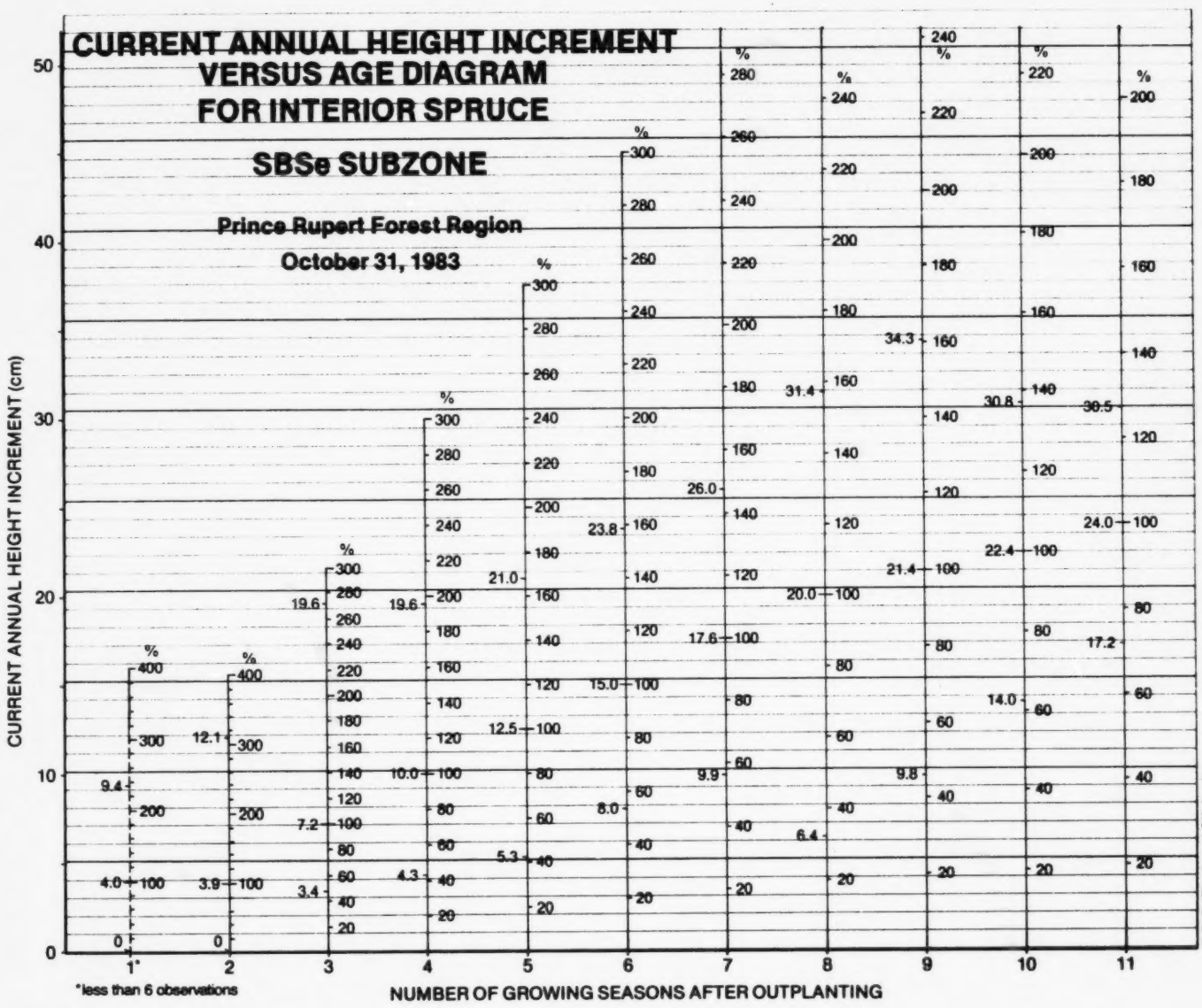

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR INTERIOR SPRUCE
SBSe SUBZONE
Prince Rupert Forest Region
October 31, 1983
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS AFTER OUTPLANTING
*less than 6 observations
F.R.O./Regional Silviculture

FIGURE 15. Current annual height increment versus age diagram for interior spruce in the SBSe subzone.

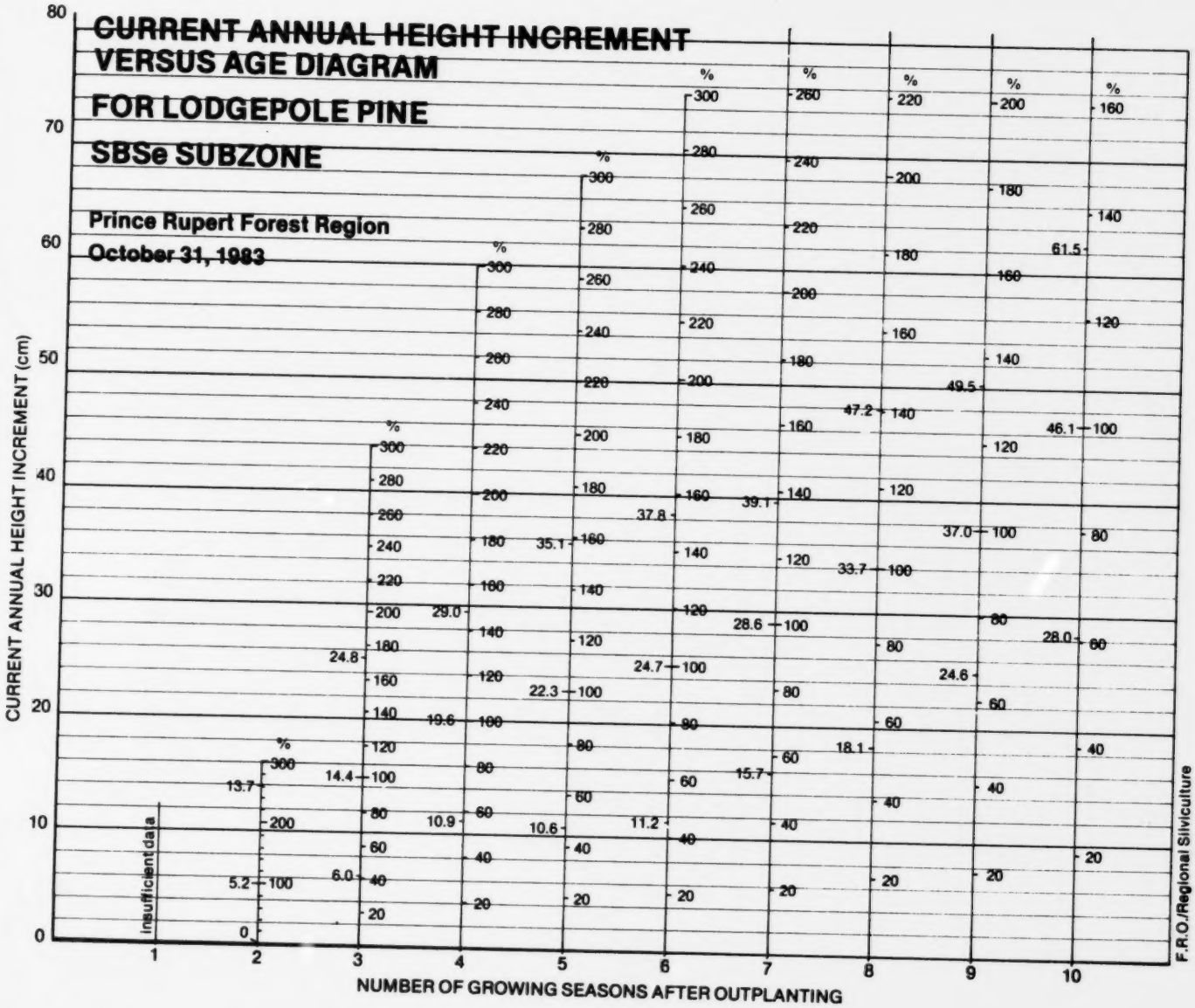


FIGURE 16. Current annual height increment versus age diagram for lodgepole pine in the SBSe subzone.

TABLE 3. Cumulative percentages of Sitka spruce plantations in the CWHf that fail to meet various height guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height guideline of: (cm)																																						
		20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430
1	28	14	82	93	93	93	93	96	100%																																		
2	31	3	42	74	90	94	94	94	97	97	100%																																
3	36	0	11	53	72	81	89	92	94	94	97	97	100%																														
4	47	0	0	15	40	70	79	81	85	91	94	96	98	98	98	100%																										
5	47	0	0	0	6	28	47	68	72	79	81	83	85	87	89	94	94	98	100%																								
6	46	0	0	0	0	2	20	43	50	65	74	78	85	85	87	91	93	98	98	98	98	98	100%																				
7	26	0	0	0	0	0	4	8	23	54	62	73	77	81	81	88	88	88	88	88	96	96	96	100%																		
8	23	0	0	0	0	0	0	4	4	9	22	48	65	70	87	91	91	91	91	96	96	96	96	96	96	100%																
9	18	0	0	0	0	0	0	0	0	6	6	6	22	33	44	50	61	78	78	89	89	89	89	89	94	94	94	94	94	94	94	100%										
10	7	0	0	0	0	0	0	0	0	0	0	14	14	14	29	29	43	43	43	43	57	57	71	71	71	71	71	71	71	86	86	86	86	86	100%							
11	7	0	0	0	0	0	0	0	0	0	0	0	0	14	14	14	14	29	29	29	43	43	43	57	57	57	57	71	71	71	71	71	71	71	86	86	86	86	86	86	86	86	100%

TABLE 4. Cumulative percentages of sitka spruce plantations in the CWHg that fail to meet various height guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height guideline of: (cm)																																						
		10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430
1	7	0	0	43	100%																																					
2	14	0	0	7	36	100%																																				
3	16	0	0	0	6	19	50	81	100%																																	
4	17	0	0	0	0	0	6	18	24	53	65	100%																														
5	27	0	0	0	0	0	4	4	11	26	30	37	48	59	70	78	93	100%																								
6	25	0	0	0	0	0	0	4	4	4	4	16	20	20	28	36	44	56	60	68	76	84	96	100%																		
7	19	0	0	0	0	0	0	0	0	5	5	5	5	5	11	11	26	26	32	37	42	58	63	74	74	84	89	95	95	100%												
8	13	0	0	0	0	0	0	0	0	0	0	0	0	8	8	8	8	8	15	15	15	31	38	38	38	46	69	77	92	92	92	92	92	100%								
9	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9	9	9	18	18	18	27	27	36	36	45	45	45	73	82	91	91	91	91	91	100%		
10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	20	20	20	30	30	30	30	40	40	50	50	80	90	90	90	90	90	100%

TABLE 5. Cumulative percentages of hybrid spruce plantations in the ICHg that fail to meet various height guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height guideline of: (cm)																												
		10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
1	7	0	0	86	100%																										
2	12	0	8	75	100%																										
3	16	0	0	19	50	94	100%																								
4	20	0	0	0	20	50	75	95	100%																						
5	26	0	0	0	8	23	42	58	77	92	100%																				
6	33	0	0	0	3	9	12	24	48	64	73	85	94	100%																	
7	35	0	0	0	0	6	9	11	14	37	60	74	83	89	100%																
8	32	0	0	0	0	3	3	9	16	16	22	34	59	66	78	88	94	100%													
9	30	0	0	0	0	0	3	3	7	13	17	17	23	27	60	70	77	87	93	93	100%										
10	26	0	0	0	0	0	0	4	4	4	8	12	15	15	15	31	58	69	77	81	88	92	96	100%							
11	20	0	0	0	0	0	0	0	0	5	5	5	10	20	20	20	20	25	55	60	80	80	90	90	90	95	95	100%			
12	13	0	0	0	0	0	0	0	0	0	0	8	8	8	8	15	23	23	23	23	62	69	69	69	92	92	92	92	92	92	100%

TABLE 6. Cumulative percentages of lodgepole pine plantations in the ICHg that fail to meet various height guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height guideline of:																																				
		10 (cm)	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
1	3	0	0	0	67	100%																																
2	3	0	0	0	33	33	67	67	100%																													
3	7	0	0	0	0	14	43	43	57	86	86	100%																										
4	16	0	0	0	0	0	6	12	50	56	69	81	88	88	100%																							
5	24	0	0	0	0	0	0	0	8	12	29	42	50	62	79	88	96	96	100%																			
6	22	0	0	0	0	0	0	0	0	0	5	9	18	41	45	55	68	82	91	95	100%																	
7	21	0	0	0	0	0	0	0	0	0	0	0	5	5	5	14	24	43	48	62	81	86	90	95	100%													
8	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	14	24	29	43	48	71	76	86	90	90	90	100%								
9	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6	24	24	24	41	47	59	71	82	94	94	94	94	94	100%		
10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	12	25	25	25	50	75	75	75	88	88	100%		

TABLE 7. Cumulative percentages of interior spruce plantations in the SBSe that fail to meet various height guidelines.

Growing seasons after planting	n	Percentage of plantations that fail to meet a height guideline of:																					
		10 (cm)	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230
1	34	0	76	100%																				
2	54	0	46	93	94	98	100%																	
3	63	0	5	71	94	95	98	98	100%															
4	71	0	0	13	75	92	96	97	99	99	100%													
5	73	0	0	1	14	62	85	94	96	97	99	100%												
6	75	0	0	0	1	11	41	73	85	96	99	99	99	100%										
7	49	0	2	2	2	4	8	20	57	78	88	90	98	98	98	98	100%							
8	32	0	0	3	3	3	3	6	9	28	66	84	91	94	100%									
9	26	0	0	0	4	4	4	4	12	19	23	31	69	85	85	88	92	100%						
10	18	0	0	0	0	6	6	6	6	6	17	22	22	28	67	72	78	83	83	89	100%			
11	16	0	0	0	0	0	0	6	6	6	6	6	12	25	25	25	50	62	75	81	81	88	88	100%

TABLE 8. Cumulative percentages of lodgepole pine plantations in the SBSe that fail to meet various height guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height guideline of:																															
		10 (cm)	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320
1	14	0	77	100%																													
2	24	0	33	96	100%																												
3	29	0	0	21	88	97	100%																										
4	53	0	0	2	15	55	81	94	100%																								
5	83	0	0	0	4	10	28	58	78	86	93	99	100%																				
6	72	0	0	0	0	0	4	7	29	53	71	86	86	92	92	100%																	
7	66	0	0	0	0	0	0	2	4	8	20	33	52	68	85	91	97	99	100%														
8	61	0	0	0	0	0	0	0	0	2	3	5	7	16	33	54	67	79	84	92	95	98	100%										
9	56	0	0	0	0	0	0	0	0	0	0	0	2	5	5	7	12	30	45	62	70	82	84	89	95	96	98	100%					
10	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	6	6	9	16	25	41	53	62	62	69	72	78	84	94	97	100%

TABLE 9. Cumulative percentages of sitka spruce plantations in the CWHf that fail to meet various height increment guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height increment guideline of:																																										
		2 (cm)	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70								
1	5	20	40	60	80	100%																																								
2	27	11	26	44	63	70	74	78	85	96	96	100%																																		
3	31	0	6	13	29	45	61	68	77	77	84	84	90	90	100%																														
4	36	0	0	0	8	22	42	47	64	69	75	83	83	83	86	89	97	100%																											
5	47	0	0	0	0	4	11	23	43	49	53	64	72	74	77	81	81	87	87	89	89	89	89	89	91	91	94	96	98	98	98	100%												
6	41	0	0	0	0	0	2	10	22	37	44	54	68	71	73	78	78	80	80	80	83	88	88	93	95	95	100%																	
7	24	0	0	0	0	4	4	8	21	37	50	71	83	83	83	83	83	83	83	83	83	83	83	83	83	87	92	92	92	92	92	92	96	96	96	100%								
8	23	0	0	0	0	0	0	4	4	9	17	30	48	65	65	78	83	91	91	91	91	91	91	91	96	100%																		
9	18	0	0	0	0	0	0	0	6	6	11	17	33	39	39	39	56	67	72	72	72	72	83	83	89	94	94	94	100%															
10	7	0	0	0	0	0	0	0	0	0	14	14	14	29	29	43	43	43	57	57	57	57	71	71	86	86	86	86	86	100%														
11	7	0	0	0	0	0	0	0	0	0	0	0	0	14	14	14	14	29	43	43	43	43	43	57	57	57	57	57	71	86	86	86	100%											

TABLE 10. Cumulative percentages of Sitka spruce plantations in the CWHg that fail to meet various height increment guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height increment guideline of:																																
		2 (cm)	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
2	7	0	14	28	28	57	86	86	86	100%																								
3	14	0	0	0	7	7	14	14	14	21	36	50	64	86	86	100%																		
4	16	0	0	0	0	0	0	0	0	0	6	19	19	19	19	25	31	44	62	88	94	100%												
5	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	18	24	35	47	47	53	65	71	82	94	100%						
6	25	0	0	0	0	0	4	4	4	4	4	4	8	8	8	16	16	16	20	20	20	36	36	48	64	68	76	80	96	96	96	96	100%	
7	19	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	11	11	11	11	11	26	26	37	47	63	63	74	95	95	95	100%	
8	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	15	15	23	31	31	31	38	46	62	69	92	100%	
9	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	18	18	18	27	36	55	64	64	73	91	100%
10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	30	30	40	40	40	40	50	50	60	80	80	80	90	100%

TABLE 11. Cumulative percentages of hybrid spruce plantations in the ICHg that fail to meet various height increment guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height increment guideline of:																																						
		1 (cm)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
2	7	0	14	29	29	29	29	86	100%																															
3	12	0	0	0	8	17	17	33	42	50	50	50	67	67	83	100%																								
4	16	0	0	0	6	6	6	6	6	6	6	38	50	50	56	56	56	62	69	81	88	88	100%																	
5	20	0	0	0	5	5	5	10	10	10	10	10	15	25	30	45	45	45	55	60	60	75	80	90	95	95	95	100%												
6	26	0	0	0	0	0	0	4	4	4	4	8	12	12	12	15	23	35	38	42	42	50	54	62	65	77	77	85	88	88	88	96	96	100%						
7	26	0	0	0	0	0	0	0	0	0	4	4	4	8	8	12	27	31	31	46	54	62	73	88	92	92	96	96	96	96	100%									
8	30	0	0	3	3	3	3	3	3	3	3	3	3	7	7	13	17	20	33	50	50	57	57	67	73	77	83	87	87	90	90	90	93	97	97	100%				
9	28	0	0	0	0	0	4	4	4	4	4	4	4	4	7	11	11	18	18	18	29	39	57	64	71	75	82	82	89	89	93	93	100%							
10	26	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	8	12	19	35	42	50	54	58	69	77	81	81	85	88	88	96	96	96	96	100%			
11	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	35	40	60	65	65	70	75	75	75	75	85	85	90	90	90	95	95	100%		
12	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	15	23	23	46	54	54	62	62	69	77	77	77	77	77	77	85	85	92	100%	

TABLE 12. Cumulative percentages of lodgepole pine plantations in the ICHg that fail to meet various height increment guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height increment guidelines of:																															
		2 (cm)	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	
2	3	0	33	33	33	33	33	33	67	67	67	67	100%																				
3	3	0	0	0	0	33	33	33	33	33	33	33	67	67	67	100%																	
4	7	0	0	0	0	0	0	0	0	14	29	29	57	57	71	86	86	86	100%														
5	16	0	0	0	0	0	0	0	0	0	6	19	31	44	62	69	75	81	88	94	100%												
6	22	0	0	0	0	0	0	0	5	9	18	18	18	27	45	64	68	82	86	91	95	95	100%										
7	21	0	0	0	0	0	0	0	0	0	0	0	5	5	14	29	52	52	71	81	86	86	86	95	95	100%							
8	21	0	0	0	0	0	0	0	0	0	0	0	0	0	5	14	19	33	43	57	67	81	86	86	90	90	95	95	95	95	100%		
9	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	24	41	47	47	47	47	53	71	76	82	88	94	94	94	100%	
10	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	50	62	62	75	75	75	75	75	88	100%					

TABLE 13. Cumulative percentages of interior spruce plantations in the SBSe that fail to meet various height increment guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height increment guideline of:																																
		1 (cm)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2	34	15	26	47	68	91	94	97	97	97	97	97	100%																						
3	54	0	0	7	22	39	57	67	82	89	93	94	96	98	98	98	98	98	98	100%															
4	63	0	0	0	5	8	11	21	38	57	62	76	87	89	95	97	98	98	98	100%															
5	71	0	0	0	0	3	3	7	10	21	37	48	58	65	78	87	93	94	99	99	99	100%													
6	64	0	0	0	0	0	0	2	2	3	8	19	30	41	52	66	73	80	83	92	97	97	98	100%											
7	48	0	0	0	0	0	0	0	0	2	4	4	4	12	19	29	48	58	65	77	79	92	96	98	98	98	100%								
8	31	0	0	0	0	0	3	3	3	3	3	3	6	6	6	13	13	29	36	48	64	84	87	87	87	87	90	97	97	97	97	100%			
9	23	0	0	0	0	0	0	0	0	4	4	4	4	4	9	9	9	22	26	39	52	61	61	70	78	87	96	96	96	96	96	96	96	96	100%
10	18	0	0	0	0	0	0	0	0	0	0	0	0	6	11	11	11	11	11	22	33	56	61	67	72	83	89	89	89	89	100%				
11	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	19	31	38	50	56	69	81	81	88	94	100%				

TABLE 14. Cumulative percentages of lodgepole pine plantations in the SBSe that fail to meet various height increment guidelines

Growing seasons after planting	n	Percentage of plantations that fail to meet a height increment guideline of: (cm)																														
		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62
2	13	8	31	62	85	92	92	100%																								
3	24	0	0	0	12	21	37	54	67	67	79	88	96	100%																		
4	29	0	0	0	0	0	3	10	24	41	66	66	76	90	97	100%																
5	53	0	0	0	0	0	2	4	9	23	34	55	68	76	81	91	96	96	100%													
6	72	0	0	0	0	0	1	1	4	4	15	33	46	61	78	86	93	94	99	100%												
7	66	0	0	0	0	0	0	0	2	3	8	11	15	29	44	54	76	88	97	98	100%											
8	59	0	0	0	0	0	0	0	0	0	2	2	3	7	17	29	42	58	66	80	85	88	93	98	100%							
9	56	0	0	0	0	0	0	0	0	0	0	0	0	4	9	12	20	29	46	59	66	77	88	93	98	100%						
10	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	9	9	12	16	25	38	50	59	69	72	75	88	97	97	100%

6 REFERENCES

B.C. Ministry of Forests. 1982. Silviculture Manual. Silviculture Branch, Victoria, B.C.

Vyse, A. 1981. Growth of young spruce plantations in interior British Columbia. For. Chron. 57(2):174-180.

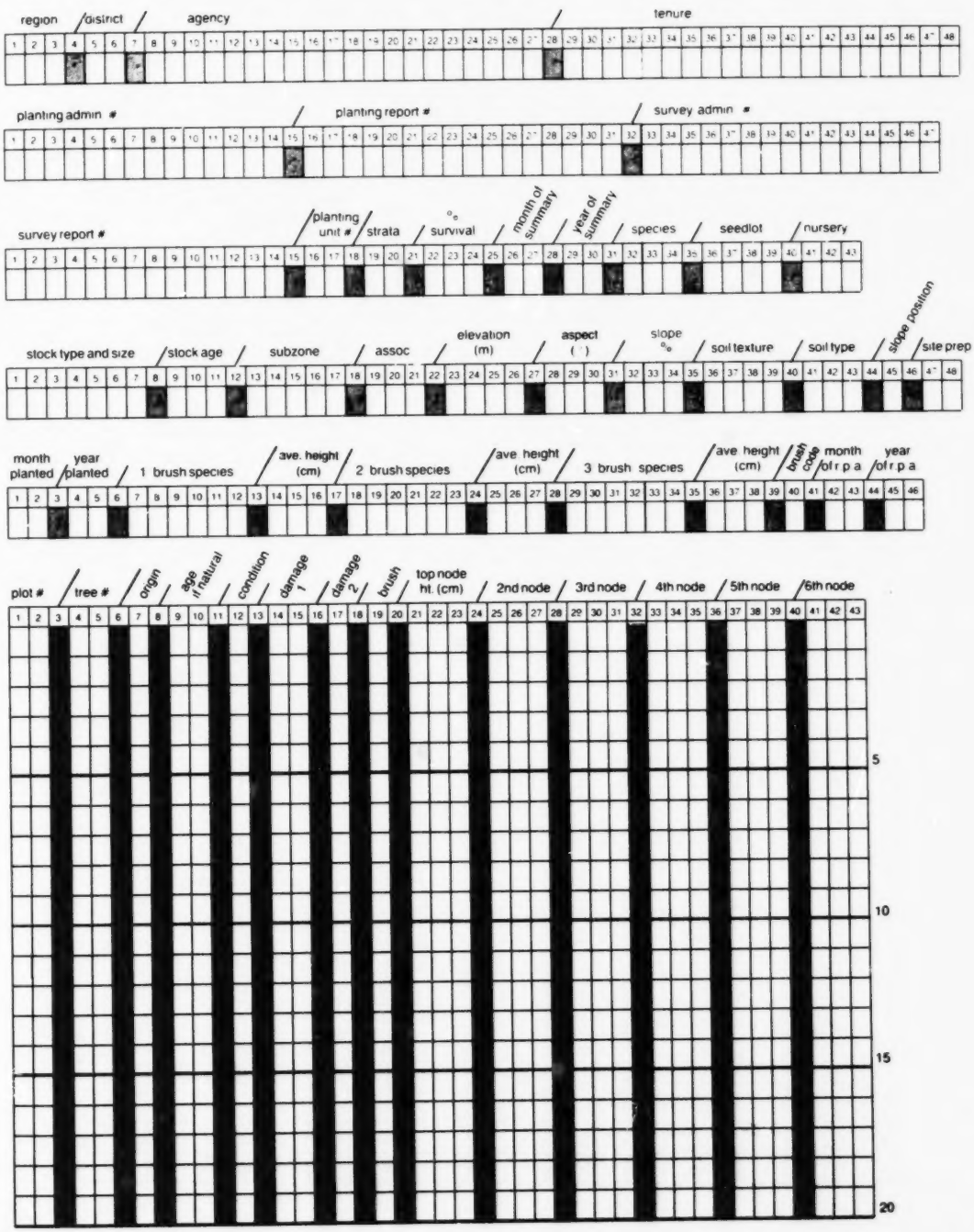
Appendices

APPENDIX 1. Computerized field survey form and coding instructions

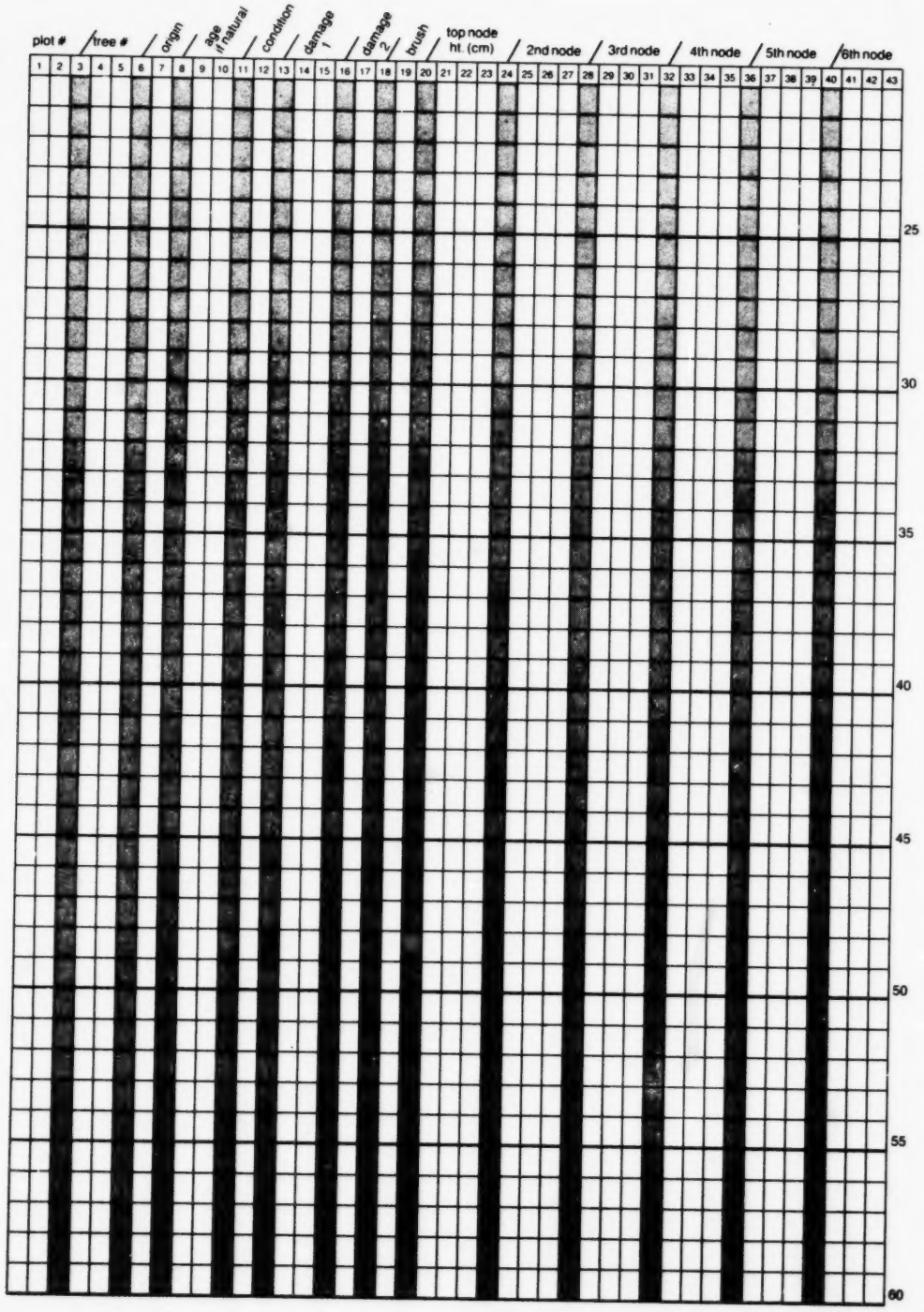
REGENERATION PERFORMANCE ASSESSMENT

Field Coding Form

Date _____ Crew Chief _____ Location _____



APPENDIX 1.(continued)

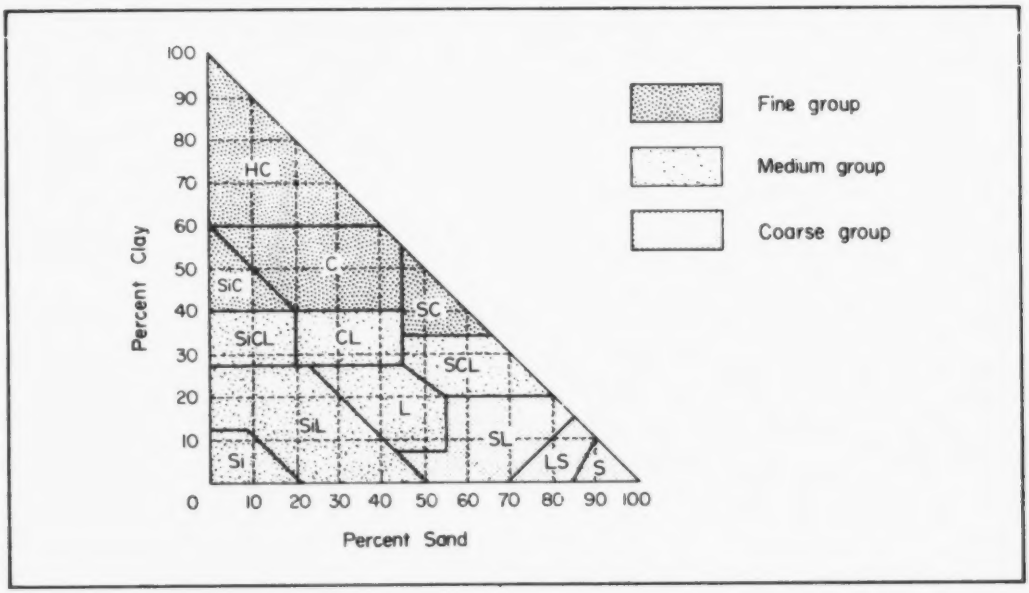


REGENERATION PERFORMANCE CODING KEY

Line	Columns	Entry	Codes
1	1 - 3	Region	N = Nelson C = Cariboo V - Vancouver K = Kamloops G = Prince George R = Prince Rupert
	5 - 6	District	appropriate numeric code
	8 - 27	Agency	BCFS or company name
	29 - 30	Tenure	Type and Number
2	1 - 14	Planting Administration Number	as required
	16 - 31	Planting Report Number	as required
	33 - 47	Survey Administration Number	as required
3	1 - 14	Survey Report Number	as required
	16 - 17	Planting Unit Number	as required
	19 - 20	Strata	see Section 4.1 on page 9
	22 - 24	Survival	plantation survival as noted from history records
	26 - 27	Month of Summary	month of survival survey
	29 - 30	Year of Summary	year of survival survey
	32 - 34	Species	HW = western hemlock PL = lodgepole pine SI = interior spruce

Line	Columns	Entry	Codes
			WW = white spruce SS = Sitka spruce SE = Engelmann spruce CW = western redcedar FI = interior Douglas-fir FC = coastal Douglas-fir (USE Inventory Branch guidelines)
	36 - 39	Seedlot	as required
	41 - 43	Nursery	SKN = Skimikin RRK = Red Rock HRP = Harrop TKW = Telkwa VRN = Vernon RMO = Remo CRN = Campbell River KOK = Duncan and Koksilah GTN = Green Timbers SRY = Surrey CHK = Chilliwack
4	1 - 7	Stock Type and Size	Stock type MP = mudpack BR = bareroot PSB = styroblock CPP = paperpots CBW = Walters' bullet PSL = Spencer-Lemaire Size: 211, 313, 415, etc.
	9 - 11	Stock Age	1+0, 2+0, etc.
	13 - 17	Subzone	see ecological classification guides (SBSe, CWHf1, etc.)
	19 - 21	Association	see ecological classification guides (01, 02, etc.)
	23 - 26	Elevation	elevation in metres
	28 - 30	Aspect	aspect in degrees (360^{o} scale) i.e. 270^{o} = due West

Line	Columns	Entry	Codes
	32 - 34	Slope	slope in percent
	36 - 39	Soil Texture	See diagram (C = clay, CL = clay loam)



	41 - 43	Soil Type	B = brunisol G = gleysol P = podzol L = luvisol R = regosol GR, GB etc. = gleyed regosol, gleyed brunisol, etc.
	45	Slope Position	A = crest B = upper slope C = middle slope D = lower slope E = toe F = depression G = level of valley bottom H = knoll I = plateau

Line	Columns	Entry	Codes
	47 - 48	Site Preparation	U = untreated BB = broadcast burned WB = windrowed and burned PB = piled and burned BL = bladed PS = patch scarified (Bracke, etc.) PM = patch scarified and mounded DT = disc trenched DS = drag scarified (anchor chains) C = chopped (Marden)
5	1 - 2	Month Planted	01 = January, 02 = February, etc.
	4 - 5	Year planted	84 = 1984, etc.
	7 - 12 18 - 23 29 - 34	Brush species (in order of site dominance)	ALNUS = alder species CORSER = red osier dogwood POPTRI = cottonwood SALIX = willow species OPLHOR = Devil's club VEBEDU = high bush cranberry RUBPAR = thimbleberry RUBSPE = salmonberry RUBIDA = raspberry AMEALN = serviceberry RIBBRA = stink currant GYMDRY = oak fern DRYASS = spiny wood fern POLMUN = sword fern PTEAGU = bracken fern LONINV = black twinberry SAMRAC = red elderberry

Note: Brush codes for all other plants should use the first three letters of the genus and species names.

Line	Columns	Entry	Codes
5	14 - 16, 25 - 27, 36 - 38	Average Brush Height	estimated average height of each major brush species in the plantation.
	40	Brush Code	

DISTRIBUTION CODES

Class	Description	Guidelines for Field Assessment*				
		No. of plants in plot (20 m x 20 m) MOF**	No. of plants/ha (100 m x 100 m) MOE**	Distance Between Plant Crowns Average MOE**	No. of Plants Within Visual Range MOE**	DIAGRAM MOE** MOF**
1	rare individual, a single occurrence	1	<5	>50 m	1	
2	a few sporadically occurring individuals	2 - 5	5 - 50	>10 m	5 - 25	
3	a single patch or clump of a species	1 patch (occupying an area smaller than one quadrant of the plot)	variable (3 patches)	>50 m between patches; less than 1 crown width apart in patch (<25 cm)	variable (3 patches)	
4	several sporadically occurring individuals	≥6	>50	>10 m	25 - 100	
5	a few patches or clumps of a species	2 - 5 patches (each occupying an area smaller than one quadrant of the plot)	variable (3 - 10 patches)	>25 m between patches; less than 1 crown width apart in patch (<25 cm)	variable (3 - 10 patches)	
6	several well spaced patches or clumps	≥6 patches (each occupying less than one quadrant of the plot)	variable (10 - many disjunct patches)	<25 m between patches <25 cm in patch	variable (10 - many disjunct patches)	
7	continuous uniform occurrence of well spaced individuals	many	many	<10 m and more than 1 crown width (>25 cm)	many	
8	continuous occurrence of a species with a few gaps in the distribution	many	many (continuous matrix formed by species crowns with some openings)	less than 1 crown width (<25 cm)	many (continuous matrix formed by species crowns with some openings)	
9	continuous dense occurrence of a species	many	many	crown closure	many (no openings evident in crown canopy)	

* The distribution code is determined over a sufficiently large area to account for normal variation in distribution pattern.
**Guidelines used for field assessment by:
MOF - Ministry of Forests, Research Branch
MOE - Ministry of Environment, Resource Analysis Branch

(Adapted from Describing Ecosystems in the Field. 1980).

42 - 43	Month of r.p.a.	as required (01 = Jan, etc.)
45 - 46	Year of r.p.a.	as required (84 = 1984 etc.)

Line	Columns	Entry	Codes
6 - 66	1 - 2	Plot Number	as required
	4 - 5	Tree Number	as required
	7	Origin	P = planted N = natural from seed after harvest A = advanced regeneration
	9 - 10	Age	# of growing seasons since planting if planted, total age if natural
	12	Condition	1 = Good: healthy, vigorous, undamaged 2 = Fair: seedling likely to overcome present defects including slight discoloration 3 = Poor: likely to die, not a crop tree (excluding Multiple Leaders). DO NOT MEASURE
	14 - 15 and 17	Damage 1 (General) -- = no damage	Damage 2 (Specifics) - = no previous damage R = recovered from damage
		FR = frost	H = (frost) heaving B = (frost) burn
		SN = snow	B = breakage P = (snow) press
		DR = drought	- = no comments
		DI = disease	A = Armillaria B = blister rust or other F = Fomes G = gallrust M = mistletoe P = Phellinus R = Rhizina S = stem canker
		IN = insects	A = aphids B = beetle C = cutworm D = defoliator R = root collar weevil S = Sequoia pitch moth T = terminal weevil

Line	Columns	Entry	Codes
		RO = rodents	H = hare P = porcupine R = rabbit S = squirrel V = vole or mouse
		BR = browsing	D = deer E = elk M = moose
		CA = cattle	T = trampling
		LE = lean	F = flooding P = poor planting
		ML = multiple leaders	D = dominance expressed N = no dominance expressed
		BA = basal sweep	A = advanced regeneration C = (soil) creep P = poor planting
		OR = other	e.g. H = hail S = smothering
	19	Brush	B = brush height below seedlings; no suppression E = brush height equal to seedlings; partial suppression F = brush height above seedlings; total suppression
	21 - 23 25 - 27 29 - 31 33 - 35 37 - 39 41 - 43	Node Heights	See Section 4.4 on page 9

APPENDIX 2. SAS programs for data analysis

```
1.      ==========================================================================
2.
3.          TO ANALYZE THE DATA COLLECTED IN THE PLANTATION PERFORMANCE
4.          ASSESSMENTS, 3 BASIC PROGRAMS WERE SET UP.
5.          (RESEARCH BRANCH SAS.EXECLIB WAS USED FOR SETTING UP THE BASIC
6.           PROGRAMS)
7.
8.          EACH PROGRAM CAN BE ADAPTED TO SUIT INDIVIDUAL NEEDS, BY ADDING
9.          SPECIFIC SORTS AND PROC STEPS, AS REQUIRED.
10.
11.         THE FIRST PROGRAM USES THE NEWLY ENTERED RAW DATASET, AND IS
12.         DESIGNED TO DETECT ERRORS IN THE 5 LEADER LINES OF EACH RECORD.
13.         (A RECORD CONSISTS OF 5 LEADER LINES, FOLLOWED BY 60 DATALINES,
14.          AS PER THE RPA FIELD CODING FORM; IF LESS THAN 60 TREES WERE
15.          MEASURED, BLANK LINES HAVE TO BE ADDED TO BRING THE TOTAL NUMBER
16.          OF DATALINES TO 60 !!!)
17.
18.         THE PROGRAM PRODUCES A LEADERLINE DATALIST, AS WELL AS VARIOUS
19.         FREQUENCY TABLES OF IMPORTANT VARIABLES SO THAT INCONSISTENCIES
20.         WILL BE DETECTED AND CORRECTED.
21.
22.
23.     ==========================================================================
24.
25.         PROGRAM 'RPAFREQ':
26.        ------------------
27.
28.     //  EXEC SAS
29.     //RAWIN DD DSN=SC88969.DRRPA...,DISP=SHR
30.     //SYSIN DD *
31.
32.       DATA DSNAME;                                                          **;
33.         INFILE RAWIN;
34.       INPUT REGION $ 1-3 DISTRICT $ 5-6 AGENCY $ 8-27 TENURE $ 29-48
35.          #3 OPENING $ 1-14 UNIT $ 16-17 STRATA 19-20 SURV 22-24 SM 26-27
36.             SY 29-30 SPECIES $ 32-34 SEEDLOT 36-39 NURSERY $ 41-43
37.          #4 STOCK $ 1-7 STA $ 9-11 SUBZONE $ 13-17 ASS $ 19-21 ELEV 23-26
38.             ASP 28-30 SLOPE 32-34 TXT $ 36-39 SOIL $ 41-43 SPOS $ 45 SPREP $ 47-48
39.          #5 PM 1-2 PY 4-5 BR1 $ 7-12 BR1M 14-16 BR2 $ 18-23
40.             BR2M 25-27 BR3 $ 29-34 BR3M 36-38 BC 40 AM 42-43 AY 45-46 # 65;
41.
42.     TITLE RPA DATASETS - ERROR CHECKING PROGRAM;                            **;
43.     MACRO DSNAME DSNAME & MACRO BYOGV * NO OVERALL GROUPING VARIABLE ; %
44.        MACRO PRTOPT UNIFORM LABEL SPLIT=' ' ; * PAGE %
45.
46.     PROC SORT DATA=DSNAME ; * OUT=DSNAME;                                   **;
47.       BY SPECIES OPENING STRATA;
48.     MACRO BYOGV BY SPECIES; % MACRO OGV SPECIES %
49.     MACRO BYSORT BY SPECIES OPENING STRATA; %
50.     MACRO IDSUBSET ID OPENING STRATA; %
51.
52.     ***  FREQUENCY TABLES USING PROC FREQ;                                  **;
53.      PROC FREQ DATA=DSNAME;  BYOGV
54.          TABLES REGION*DISTRICT AGENCY*TENURE OPENING*STRATA SEEDLOT*SPECIES
55.                 NURSERY SM*SY STOCK*STA SUBZONE*ASS TXT*SOIL SPOS*SPREP
56.                 PM*PY AM*AY/
57.                   NOROW NOCOL NOPERCENT;
58.        TITLE2 FREQUENCY LISTINGS FOR LEADER LINE VARIABLES;
59.
60.     *** LISTING OF SPECIFIED VARIABLES;                                     **;
61.       PROC PRINT DATA=DSNAME PRTOPT ;  BYOGV
62.         VAR REGION DISTRICT AGENCY TENURE OPENING UNIT STRATA SURV SM SY
63.             SPECIES SEEDLOT NURSERY STOCK STA SUBZONE ASS ELEV ASP SLOPE TXT
```

APPENDIX 2. (continued)

```
64.             SOIL $POS $PREP PM PY AM AY;
65.       TITLE2 LISTING OF DATA - LEADER LINES ONLY;
66.      /*
67.      //
68.      ================================================================================
69.
70.
71.          AFTER ERROR-CHECKING AND CORRECTING OF THE RAW DATA,
72.          PROGRAM 'RPAFIRST' IS USED TO CALCULATE UNIVARIATE STATS OF
73.          HEIGHTS FOR EACH NODE, CALCULATE INCREMENTS, AND CALCULATE
74.          THE AGE OF EACH NODE.
75.
76.          THE PROGRAM OUTPUTS A NEW DATAFILE, WHICH CONTAINS THE LEADER
77.          LINES AND 6 DATALINES WITH THE APPROPRIATE STATISTICS AND NEW
78.          VARIABLES.
79.
80.
81.      ================================================================================
82.
83.          PROGRAM 'RPAFIRST':
84.          ------------------
85.
86.
87.      //  EXEC SAS
88.      //RAWIN DD DSN=SC88969.DATRPA...,DISP=SHR
89.      //RAWOUT DD DSN=SC88969.ST.....,DISP=(NEW,CATLG),UNIT=USER,
90.      //     SPACE=(TRK,(3,1),RLSE),DCB=(RECFM=FB,LRECL=80,BLKSIZE=2960)
91.      //SYSIN DD *
92.
93.        DATA DSNAME;                                                          **;
94.          INFILE RAWIN;
95.        INPUT REGION $ 1-3 DISTRICT $ 5-6 AGENCY $ 8-27 TENURE $ 29-48
96.            #3 OPENING $ 1-14 UNIT $ 16-17 STRATA 19-20 SURV 22-24 SM 26-27
97.               SY 29-30 SPECIES $ 32-34 SEEDLOT 36-39 NURSERY $ 41-43
98.            #4 STOCK $ 1-7 STA $ 9-11 SUBZONE $ 13-17 ASS $ 19-21 ELEV 23-26
99.               ASP 28-30 SLOPE 32-34 TXT $ 36-39 SOIL $ 41-43 SPOS $ 45 SPREP $ 47-48
100.           #5 PM 1-2 PY 4-5 BR1 $ 7-12 BR1H 14-16 BR2 $ 18-23
101.              BR2H 25-27 BR3 $ 29-34 BR3H 36-38 BC 40 AM 42-43 AY 45-46;
102.           ARRAY AGE(I) AGE1-AGE6 ;
103.           DO I=1 TO 6 ;
104.           AGE=AY-PY-I+1;
105.           END;
106.           DO I=1 TO 60;
107.           INPUT TOPNODE 21-23 NODE2 25-27 NODE3 29-31 NODE4 33-35
108.                 NODE5 37-39 NODE6 41-43 ;
109.           OUTPUT;
110.           END;
111.
112.       TITLE RPA ASSEMBLY OF UNIVARIATE STATS;                               **;
113.       MACRO DSNAME DSNAME % MACRO BYOGV * NO OVERALL GROUPING VARIABLE ; %
114.
115.       PROC SORT DATA=DSNAME ; * OUT=DSNAME;                                 **;
116.         BY SPECIES OPENING STRATA;
117.       MACRO BYOGV BY SPECIES; % MACRO OGV SPECIES %
118.       MACRO BYSORT BY SPECIES OPENING STRATA; %
119.       MACRO IDSUBSET ID OPENING STRATA; %
120.
121.      *** CALCULATION OF MEANS FOR SUBSETS OF THE DATA - TOPNODE;            **;
122.      MACRO MEANPRT
123.       PROC MEANS DATA=USNAME NOPRINT N MEAN STD STDERR VAR CV  ;
124.        BY SPECIES OPENING STRATA ;  VAR VARAB ; OUTPUT OUT= VARAB
125.        N=NUM1 MEAN=VARAB STD=STD1 STDERR=STDERR1 VAR=VAR1 CV=CV1;
126.       PROC PRINT DATA= VARAB ;*PAGE  ; BY SPECIES;
127.          ID OPENING STRATA;  VAR NUM1 VARAB STD1 STDERR1 VAR1 CV1;
```

APPENDIX 2. (continued)

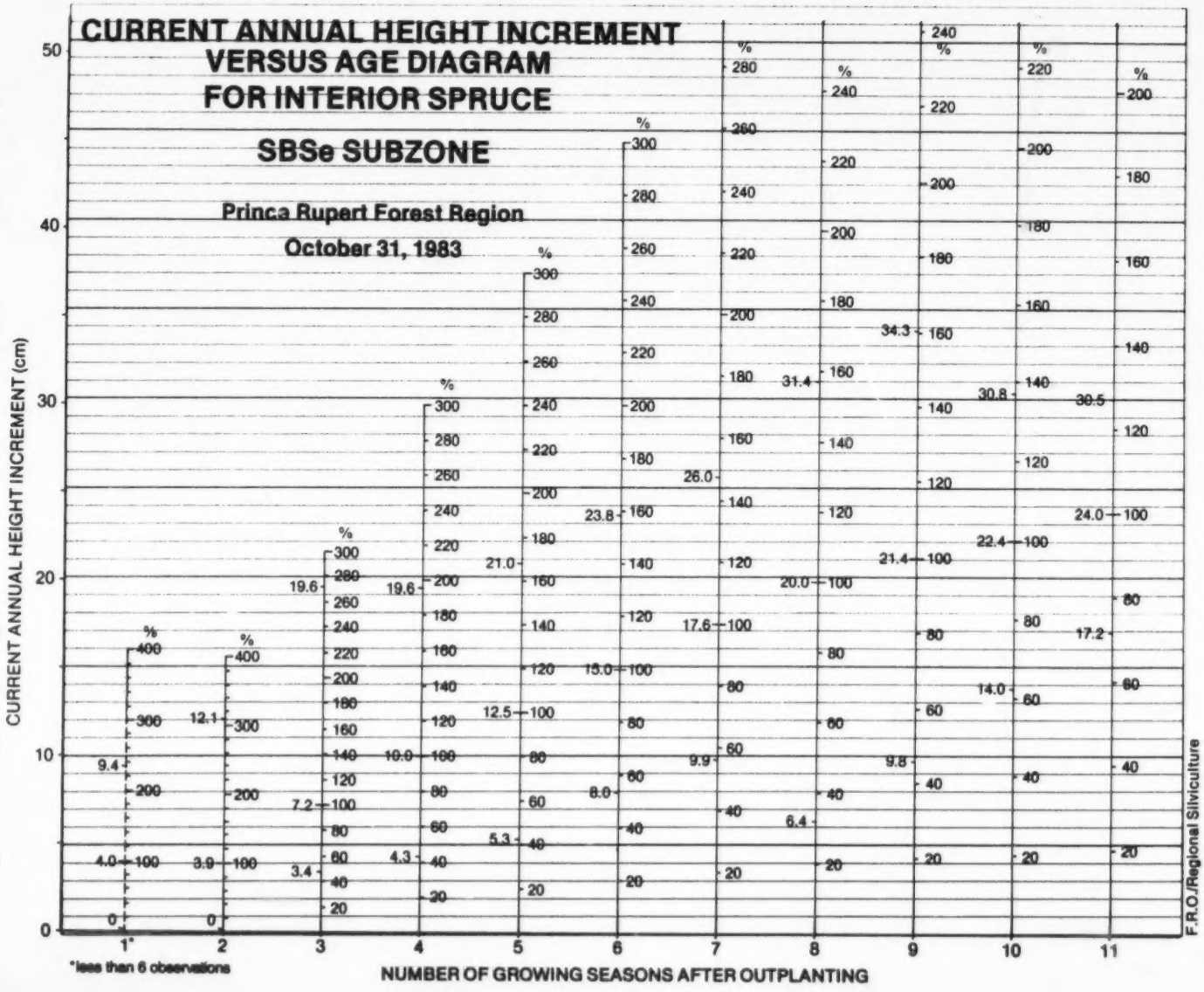
```
128.        TITLE2 LISTING OF MEANS FOR VARIABLE VARAB ; %
129.      * MACRO DSNAME DSNAME % ;  MACRO VARAB TOPNODE %  MEANPRT
130.      *** CALCULATION OF MEANS FOR SUBSETS OF THE DATA - NODE2;
131.      MACRO MEANPRT
132.       PROC MEANS DATA=DSNAME NOPRINT N MEAN STD STDERR VAR CV  ;
133.        BY SPECIES OPENING STRATA ;  VAR VARAB ; OUTPUT OUT= VARAB
134.        N=NUM2 MEAN=VARAB STD=STD2 STDERR=STDERR2 VAR=VAR2 CV=CV2;
135.       PROC PRINT DATA= VARAB ;*PAGE  ; BY SPECIES;
136.          ID OPENING STRATA;  VAR NUM2 VARAB STD2 STDERR2 VAR2 CV2;
137.          TITLE2 LISTING OF MEANS FOR VARIABLE VARAB ; %
138.        MACRO VARAB NODE2 %  MEANPRT
139.      *** CALCULATION OF MEANS FOR SUBSETS OF THE DATA - NODE3;
140.      MACRO MEANPRT
141.       PROC MEANS DATA=DSNAME NOPRINT N MEAN STD STDERR VAR CV  ;
142.        BY SPECIES OPENING STRATA ;  VAR VARAB ; OUTPUT OUT= VARAB
143.        N=NUM3 MEAN=VARAB STD=STD3 STDERR=STDERR3 VAR=VAR3 CV=CV3;
144.       PROC PRINT DATA= VARAB ;*PAGE  ; BY SPECIES;
145.          ID OPENING STRATA;  VAR NUM3 VARAB STD3 STDERR3 VAR3 CV3;
146.          TITLE2 LISTING OF MEANS FOR VARIABLE VARAB ; %
147.        MACRO VARAB NODE3 %  MEANPRT
148.      *** CALCULATION OF MEANS FOR SUBSETS OF THE DATA - NODE4;
149.      MACRO MEANPRT
150.       PROC MEANS DATA=DSNAME NOPRINT N MEAN STD STDERR VAR CV  ;
151.        BY SPECIES OPENING STRATA ;  VAR VARAB ; OUTPUT OUT= VARAB
152.        N=NUM4 MEAN=VARAB STD=STD4 STDERR=STDERR4 VAR=VAR4 CV=CV4;
153.       PROC PRINT DATA= VARAB ;*PAGE  ; BY SPECIES;
154.          ID OPENING STRATA;  VAR NUM4 VARAB STD4 STDERR4 VAR4 CV4;
155.          TITLE2 LISTING OF MEANS FOR VARIABLE VARAB ; %
156.        MACRO VARAB NODE4 %  MEANPRT
157.      *** CALCULATION OF MEANS FOR SUBSETS OF THE DATA - NODE5;
158.      MACRO MEANPRT
159.       PROC MEANS DATA=DSNAME NOPRINT N MEAN STD STDERR VAR CV  ;
160.        BY SPECIES OPENING STRATA ;  VAR VARAB ; OUTPUT OUT= VARAB
161.        N=NUM5 MEAN=VARAB STD=STD5 STDERR=STDERR5 VAR=VAR5 CV=CV5;
162.       PROC PRINT DATA= VARAB ;*PAGE  ; BY SPECIES;
163.          ID OPENING STRATA;  VAR NUM5 VARAB STD5 STDERR5 VAR5 CV5;
164.          TITLE2 LISTING OF MEANS FOR VARIABLE VARAB ; %
165.        MACRO VARAB NODE5 %  MEANPRT
166.      *** CALCULATION OF MEANS FOR SUBSETS OF THE DATA - NODE6;
167.      MACRO MEANPRT
168.       PROC MEANS DATA=DSNAME NOPRINT N MEAN STD STDERR VAR CV  ;
169.        BY SPECIES OPENING STRATA ;  VAR VARAB ; OUTPUT OUT= VARAB
170.        N=NUM6 MEAN=VARAB STD=STD6 STDERR=STDERR6 VAR=VAR6 CV=CV6;
171.       ID REGION DISTRICT AGENCY TENURE OPENING UNIT STRATA SURV SM SY
172.          SPECIES SEEDLOT NURSERY STOCK STA SUBZONE ASS ELEV ASP SLOPE
173.          TXT SOIL SPOS SPREP PM PY BR1 BR1M BR2 BR2M BR3 BR3M BC AM AY AGE1
174.          AGE2 AGE3 AGE4 AGE5 AGE6 ;
175.       PROC PRINT DATA= VARAB ;*PAGE  ; BY SPECIES;
176.          ID OPENING STRATA;  VAR NUM6 VARAB STD6 STDERR6 VAR6 CV6;
177.          TITLE2 LISTING OF MEANS FOR VARIABLE VARAB ; %
178.       MACRO VARAB NODE6 %  MEANPRT
179.       DATA;
180.        MERGE TOPNODE NODE2 NODE3 NODE4 NODE5 NODE6;
181.        BY SPECIES OPENING STRATA;
182.        ARRAY T(I) TOPNODE NODE2 NODE3 NODE4 NODE5 ;
183.        ARRAY V(I) NODE2 NODE3 NODE4 NODE5 NODE6;
184.        ARRAY INC(I) INC1-INC5;
185.        DO I=1 TO 5;
186.          INC=T-V;
187.        END;
188.        FILE RAWOUT;
189.        PUT REGION $ 1-3 DISTRICT $ 5-6 AGENCY $ 8-27 TENURE $ 29-48
190.         #2 OPENING $ 1-14 UNIT $ 16-17 STRATA 19-20 SURV 22-24 SM 26-27
191.            SY 29-30 SPECIES $ 32-34 SEEDLOT 36-39 NURSERY $ 41-43
```

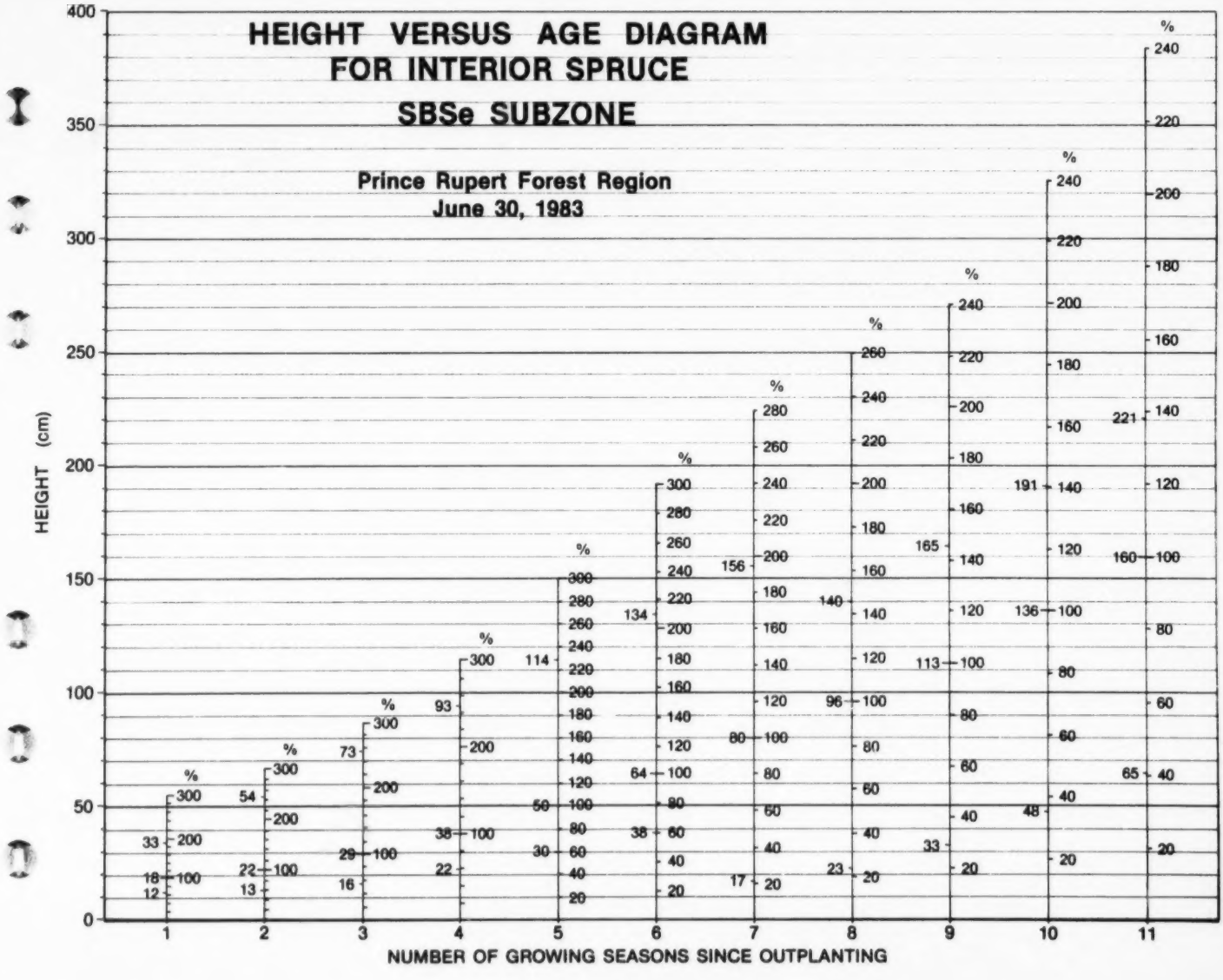
APPENDIX 2. (continued)

```
192.          #3 STOCK $ 1-7 STA $ 9-11 SUBZONE $ 13-17 ASS $ 19-21 ELEV 23-26
193.             ASP 28-30 SLOPE 32-34 TXT $ 36-39 SOIL $ 41-43 SPOS $ 45 SPREP $ 47-48
194.          #4 PM 1-2 PY 4-5 BR1 $ 7-12 BR1M 14-16 BR2 $ 18-23
195.             BR2M 25-27 BR3 $ 29-34 BR3M 36-38 BC 40 AM 42-43 AY 45-46
196.          #5 NUM1 1-3 AGE1 5-6 INC1 9-16 3 TOPNODE 18-25 3
197.             STD1 27-34 3 STDERR1 36-43 3 VAR1 45-52 3 CV1 54-61 3
198.          #6 NUM2 1-3 AGE2 5-6 INC2 9-16 3 NODE2 18-25 3
199.             STD2 27-34 3 STDERR2 36-43 3 VAR2 45-52 3 CV2 54-61 3
200.          #7 NUM3 1-3 AGE3 5-6 INC3 9-16 3 NODE3 18-25 3
201.             STD3 27-34 3 STDERR3 36-43 3 VAR3 45-52 3 CV3 54-61 3
202.          #8 NUM4 1-3 AGE4 5-6 INC4 9-16 3 NODE4 18-25 3
203.             STD4 27-34 3 STDERR4 36-43 3 VAR4 45-52 3 CV4 54-61 3
204.          #9 NUM5 1-3 AGE5 5-6 INC5 9-16 3 NODE5 18-25 3
205.             STD5 27-34 3 STDERR5 36-43 3 VAR5 45-52 3 CV5 54-61 3
206.         #10 NUM6 1-3 AGE6 5-6 NODE6 18-25 3
207.             STD6 27-34 3 STDERR6 36-43 3 VAR6 45-52 3 CV6 54-61 3;
208.      /*
209.      //
210.      ====================================================================
211.
212.
213.          THE OUTPUT DATASET, WHICH CONTAINS MEAN HEIGHTS, INCREMENTS AND
214.          AGES FOR EACH NODE IS THEN FURTHER ANALYZED USING PROGRAM 'HPAFINAL'.
215.
216.          THIS PROGRAM PROVIDES THE FOLLOWING ANALYSES:
217.             1. DATALIST OF PLANTATIONS ANALYZED;
218.             2. MEANS AND PLOTS OF HEIGHT/AGE AND INCREMENT/AGE, AS PER
219.                VARIOUS SORTS.
220.
221.        VERTICAL AXIS (VAXIS) VALUES AND INTERVALS HAVE BEEN SPECIFIED
222.        IN THIS PROGRAM TO ALLOW FOR OVERLAYING OF THE VARIOUS PLOTS;
223.        THESE VALUES MAY BE CHANGED TO ACCOMMODATE HIGHER OR LOWER
224.        MAXIMUM VALUES OF THE MEAN HEIGHT AND INCREMENT VARIABLES.
225.
226.      ====================================================================
227.
228.
229.          PROGRAM 'HPAFINAL':
230.          ------------------
231.
232.
233.      //   EXEC SAS
234.      //RAWIN DD DSN=SC88969.ST.....DISP=SHR
235.      //SYSIN DD *
236.
237.        DATA DSNAME;                                                    **;
238.          INFILE RAWIN;
239.       INPUT REGION $ 1-3 DISTRICT $ 5-6 AGENCY $ 8-27 TENURE $ 29-48
240.          #2 OPENING $ 1-14 UNIT $ 16-17 STRATA 19-20 SURV 22-24 SM 26-27
241.             SY 29-30 SPECIES $ 32-34 SEEDLOT 36-39 NURSERY $ 41-43
242.          #3 STOCK $ 1-7 STA $ 9-11 SUBZONE $ 13-17 ASS $ 19-21 ELEV 23-26
243.             ASP 28-30 SLOPE 32-34 TXT $ 36-39 SOIL $ 41-43 SPOS $ 45 SPREP $ 47-48
244.          #4 PM 1-2 PY 4-5 BR1 $ 7-12 BR1M 14-16 BR2 $ 18-23
245.             BR2M 25-27 BR3 $ 29-34 BR3M 36-38 BC 40 AM 42-43 AY 45-46;
246.           DO I = 1 TO 6 ;
247.           INPUT NUM 1-3 AGE 5-6 INC 9-16 MEANHT 18-25 ;
248.           OUTPUT ;
249.           END ;
250.
251.       TITLE PLANTATION PERFORMANCE ASSESSMENT;                         **;
252.       %MACRO DSNAME DSNAME ; %MACRO BYOGV = NO OVERALL GROUPING VARIABLE ; %
253.          %MACRO PRTOPT UNIFORM LABEL SPLIT=' ' ; * PAGE ;
254.
255.       PROC SORT DATA=DSNAME ; * OUT=DSNAME;                           **;
```

APPENDIX 2. (complete)

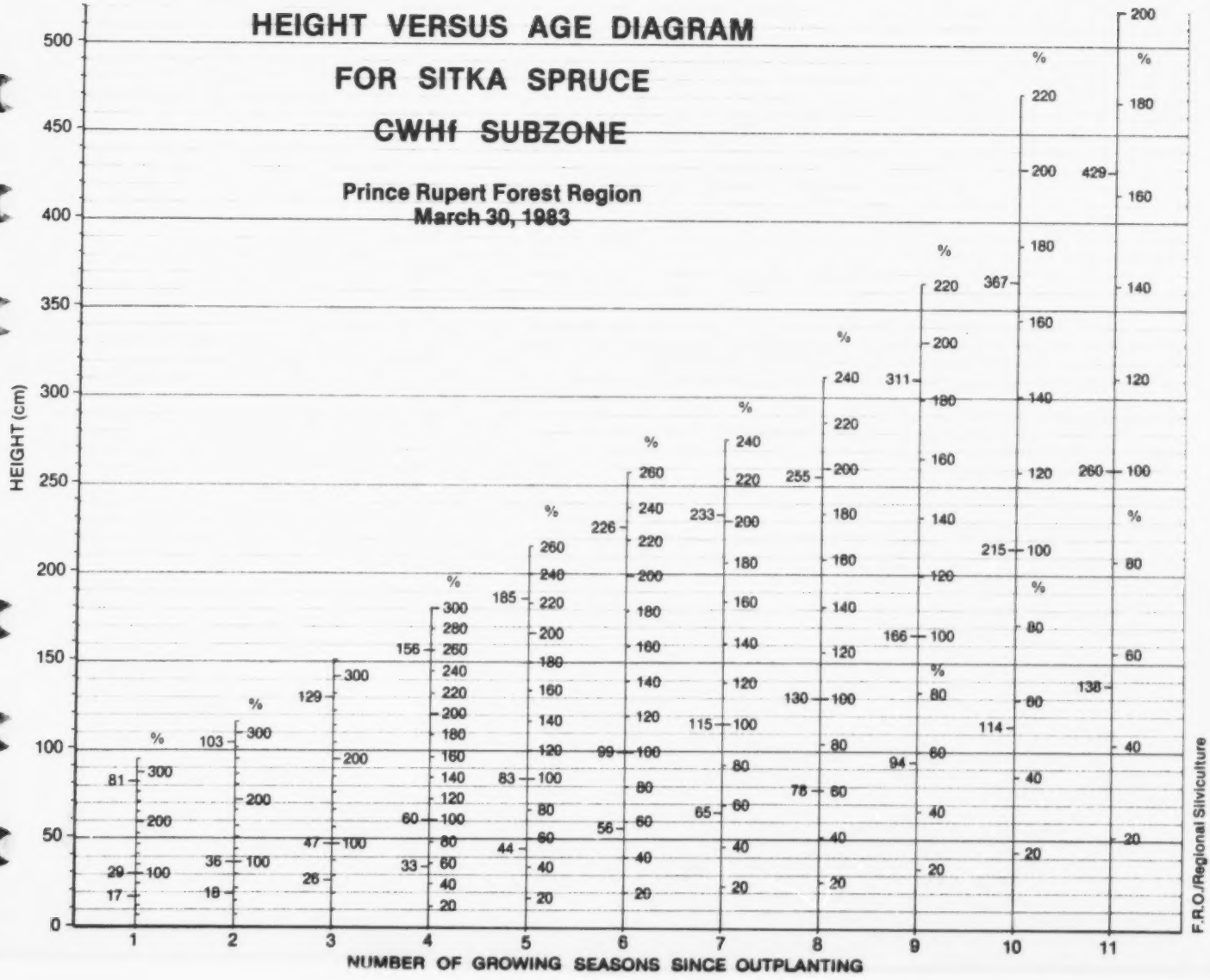
```
256.        BY SPECIES SUBZONE ; * NO SUBSET VARS ;
257.       MACRO BYOGV BY SPECIES SUBZONE; % MACRO OGV SPECIES SUBZONE %
258.       MACRO BYSORT BY SPECIES SUBZONE ; * NO SUBSET VARS ; %
259.       MACRO IDSUBSET ID ; * NO SUBSET VARS ; %
260.
261.      *** LISTING OF SPECIFIED VARIABLES;                                    **;
262.        PROC PRINT DATA=DSNAME PRTOPT ; BYOGV
263.          VAR OPENING STRATA SPECIES AGE STOCK STA SUBZONE ASS;
264.        TITLE2 LISTING OF DATA;
265.
266.       PROC SORT DATA=DSNAME ; * OUT=DSNAME;                                 **;
267.         BY SPECIES SUBZONE AGE;
268.       MACRO BYOGV BY SPECIES SUBZONE; % MACRO OGV SPECIES SUBZONE %
269.       MACRO BYSORT BY SPECIES SUBZONE AGE; %
270.       MACRO IDSUBSET ID AGE; %
271.
272.      *** MEANPLOT--PROCEDURE TO PLOT INTERACTION MEANS;                     **;
273.      MACRO MEANPLOT
274.      PROC SUMMARY DATA=DSNAME; BYOGV
275.        CLASS AGE  ;
276.        VAR VARAB; OUTPUT OUT=MEANS N=NUM MEAN=VARAB STD=STD STDERR=STDERR
277.                  VAR=VAR CV=CV MIN=MIN MAX=MAX;
278.       *;
279.      *** PLOTS AND PRINTOUTS FOR MAIN EFFECTS;
280.      DATA AGE; SET MEANS; IF  _TYPE_ EQ 1 ; FORMAT NUM 8.0 VARAB--MAX BEST10.;
281.      PROC PRINT DATA=AGE  PRTOPT ; BYOGV  ID AGE; VAR NUM--MAX;
282.          TITLE2 LISTING OF MEANS FOR VARAB FOR EACH LEVEL OF AGE;
283.      PROC PLOT DATA=AGE UNIFORM; BYOGV
284.         PLOT VARAB*AGE POPT
285.         TITLE2 PLOT OF MAIN EFFECTS FOR EACH LEVEL OF AGE FOR VARAB; %
286.      MACRO VARAB MEANMT % MACRO POPT/HSPACE=5 VAXIS=0 TO 350 BY 50;% MEANPLOT
287.      MACRO VARAB INC % MACRO POPT/HSPACE=5 VAXIS=0 TO 60 BY 10;% MEANPLOT
288.
289.       PROC SORT DATA=DSNAME ; * OUT=DSNAME;                                **;
290.         BY SPECIES SUBZONE STOCK STA AGE;
291.       MACRO BYOGV BY SPECIES SUBZONE STOCK STA;
292.         % MACRO OGV SPECIES SUBZONE STOCK STA %
293.       MACRO BYSORT BY SPECIES SUBZONE STOCK STA AGE; %
294.       MACRO IDSUBSET ID AGE; %
295.
296.      *** MEANPLOT--PROCEDURE TO PLOT INTERACTION MEANS;                     **;
297.      MACRO MEANPLOT
298.      PROC SUMMARY DATA=DSNAME; BYOGV
299.        CLASS AGE  ;
300.        VAR VARAB; OUTPUT OUT=MEANS N=NUM MEAN=VARAB STD=STD STDERR=STDERR
301.                  VAR=VAR CV=CV MIN=MIN MAX=MAX;
302.       *;
303.      *** PLOTS AND PRINTOUTS FOR MAIN EFFECTS;
304.      DATA AGE; SET MEANS; IF  _TYPE_ EQ 1 ; FORMAT NUM 8.0 VARAB--MAX BEST10.;
305.      PROC PRINT DATA=AGE  PRTOPT ; BYOGV  ID AGE; VAR NUM--MAX;
306.          TITLE2 LISTING OF MEANS FOR VARAB FOR EACH LEVEL OF AGE;
307.      PROC PLOT DATA=AGE UNIFORM; BYOGV
308.         PLOT VARAB*AGE POPT
309.         TITLE2 PLOT OF MAIN EFFECTS FOR EACH LEVEL OF AGE FOR VARAB; %
310.      MACRO VARAB MEANMT % MACRO POPT/HSPACE=5 VAXIS=0 TO 350 BY 50;% MEANPLOT
311.      MACRO VARAB INC % MACRO POPT/HSPACE=5 VAXIS=0 TO 60 BY 10;% MEANPLOT
312.                                                                           **;
313.       PROC SORT DATA=DSNAME ; * OUT=DSNAME;
314.         BY SPECIES SUBZONE ASS AGE;
315.       MACRO BYOGV BY SPECIES SUBZONE ASS; % MACRO OGV SPECIES SUBZONE ASS %
316.       MACRO BYSORT BY SPECIES SUBZONE ASS AGE; %
317.       MACRO IDSUBSET ID AGE; %
318.
319.      *** MEANPLOT--PROCEDURE TO PLOT INTERACTION MEANS;                     **;
320.      MACRO MEANPLOT
321.      PROC SUMMARY DATA=DSNAME; BYOGV
322.        CLASS AGE  ;
323.        VAR VARAB; OUTPUT OUT=MEANS N=NUM MEAN=VARAB STD=STD STDERR=STDERR
324.                  VAR=VAR CV=CV MIN=MIN MAX=MAX;
325.       *;
326.      *** PLOTS AND PRINTOUTS FOR MAIN EFFECTS;
327.      DATA AGE; SET MEANS; IF  _TYPE_ EQ 1 ; FORMAT NUM 8.0 VARAB--MAX BEST10.;
328.      PROC PRINT DATA=AGE  PRTOPT ; BYOGV  ID AGE; VAR NUM--MAX;
329.          TITLE2 LISTING OF MEANS FOR VARAB FOR EACH LEVEL OF AGE;
330.      PROC PLOT DATA=AGE UNIFORM; BYOGV
331.         PLOT VARAB*AGE POPT
332.         TITLE2 PLOT OF MAIN EFFECTS FOR EACH LEVEL OF AGE FOR VARAB; %
333.      MACRO VARAB MEANMT % MACRO POPT/HSPACE=5 VAXIS=0 TO 350 BY 50;% MEANPLOT
334.      MACRO VARAB INC % MACRO POPT/HSPACE=5 VAXIS=0 TO 60 BY 10;% MEANPLOT
335.
336.      /*                                                                     **;
337.      //
```

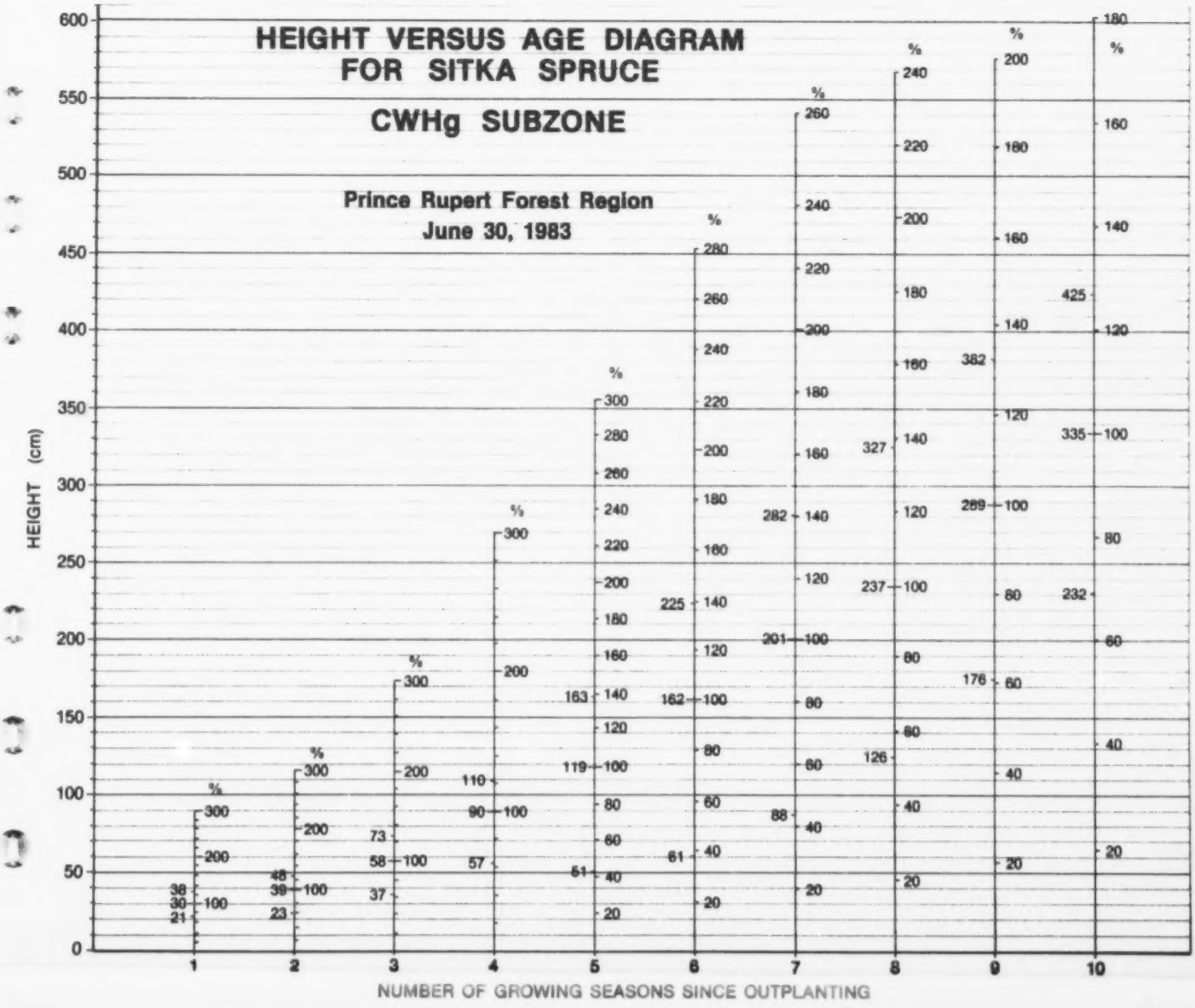

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR INTERIOR SPRUCE
SBSe SUBZONE
Prince Rupert Forest Region
October 31, 1983
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS AFTER OUTPLANTING
*less than 6 observations
F.R.O./Regional Silviculture

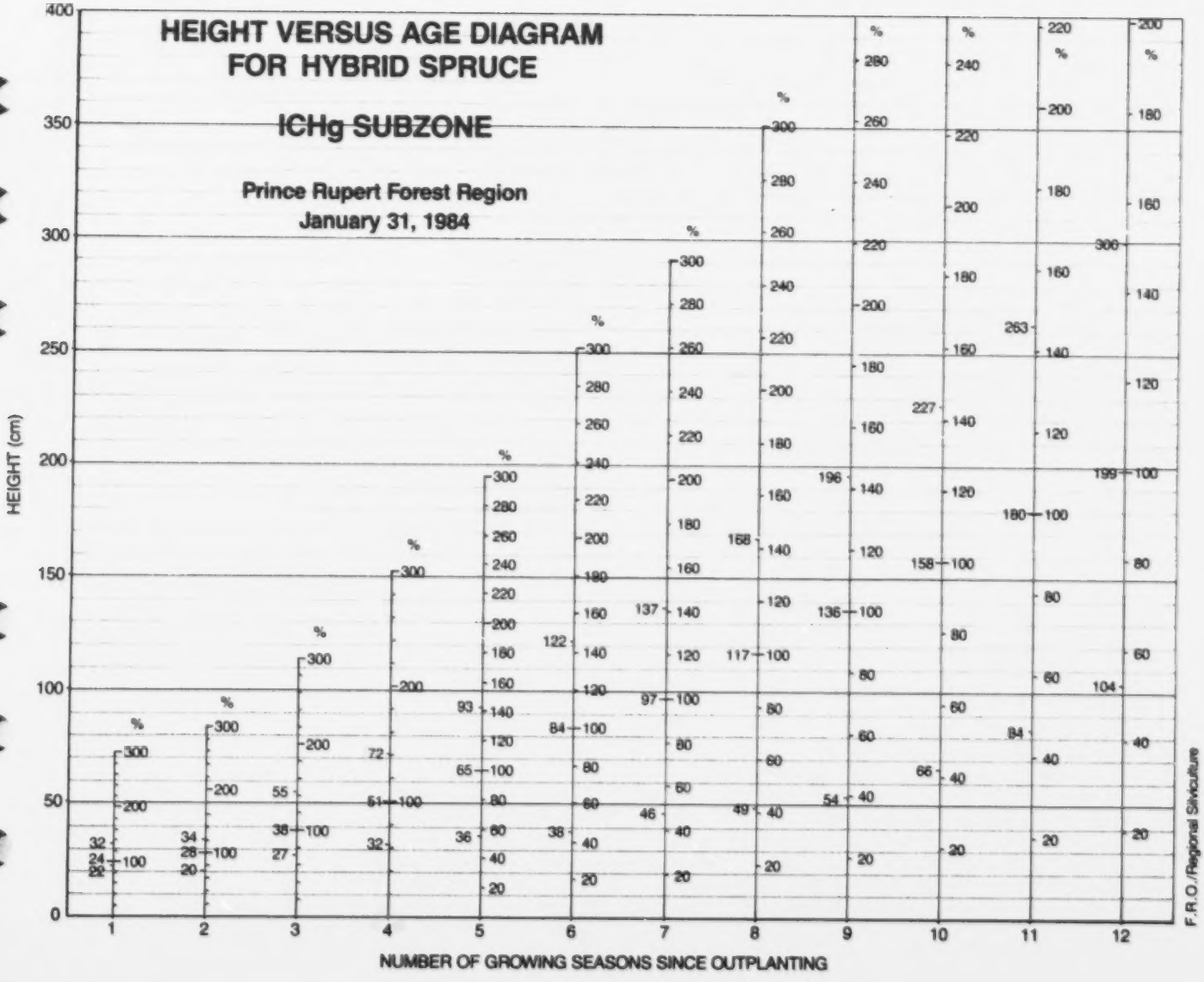

HEIGHT VERSUS AGE DIAGRAM
FOR INTERIOR SPRUCE
SBSe SUBZONE
Prince Rupert Forest Region
June 30, 1983
HEIGHT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
F.R.O./Regional Silviculture

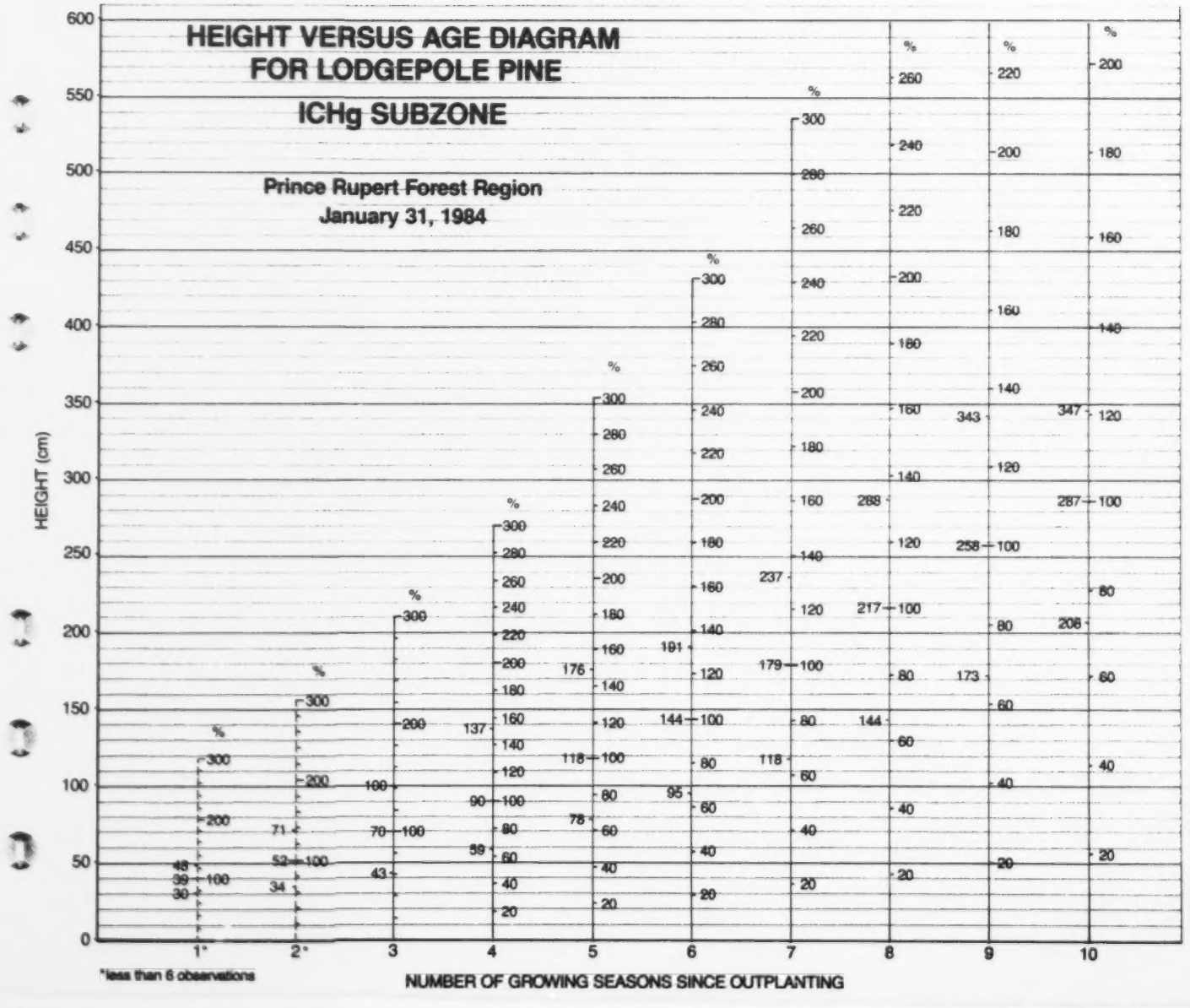
HEIGHT VERSUS AGE DIAGRAM
FOR SITKA SPRUCE
CWHf SUBZONE

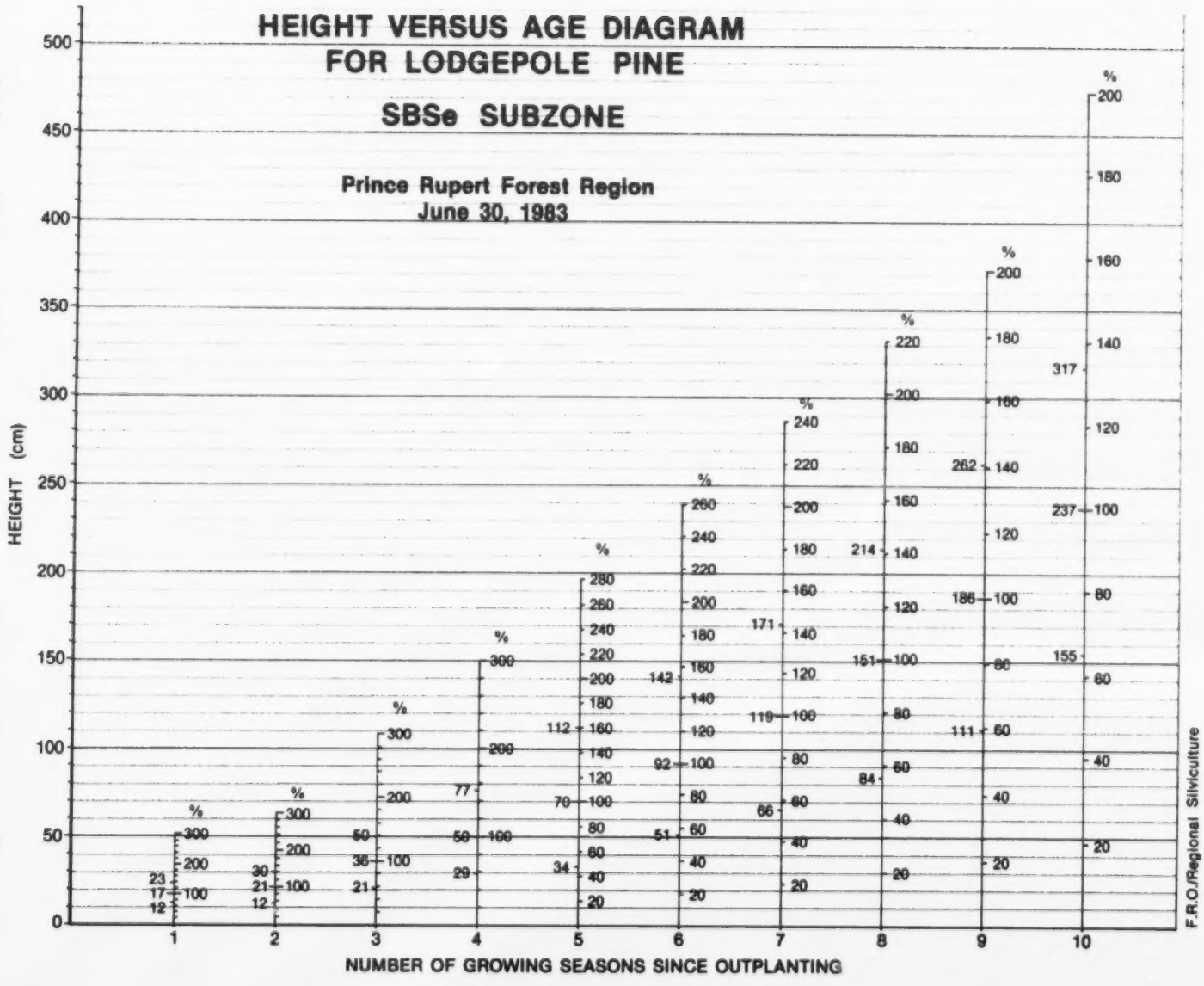
Prince Rupert Forest Region
March 30, 1983




HEIGHT VERSUS AGE DIAGRAM
FOR SITKA SPRUCE
CWHg SUBZONE
Prince Rupert Forest Region
June 30, 1983
HEIGHT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
%

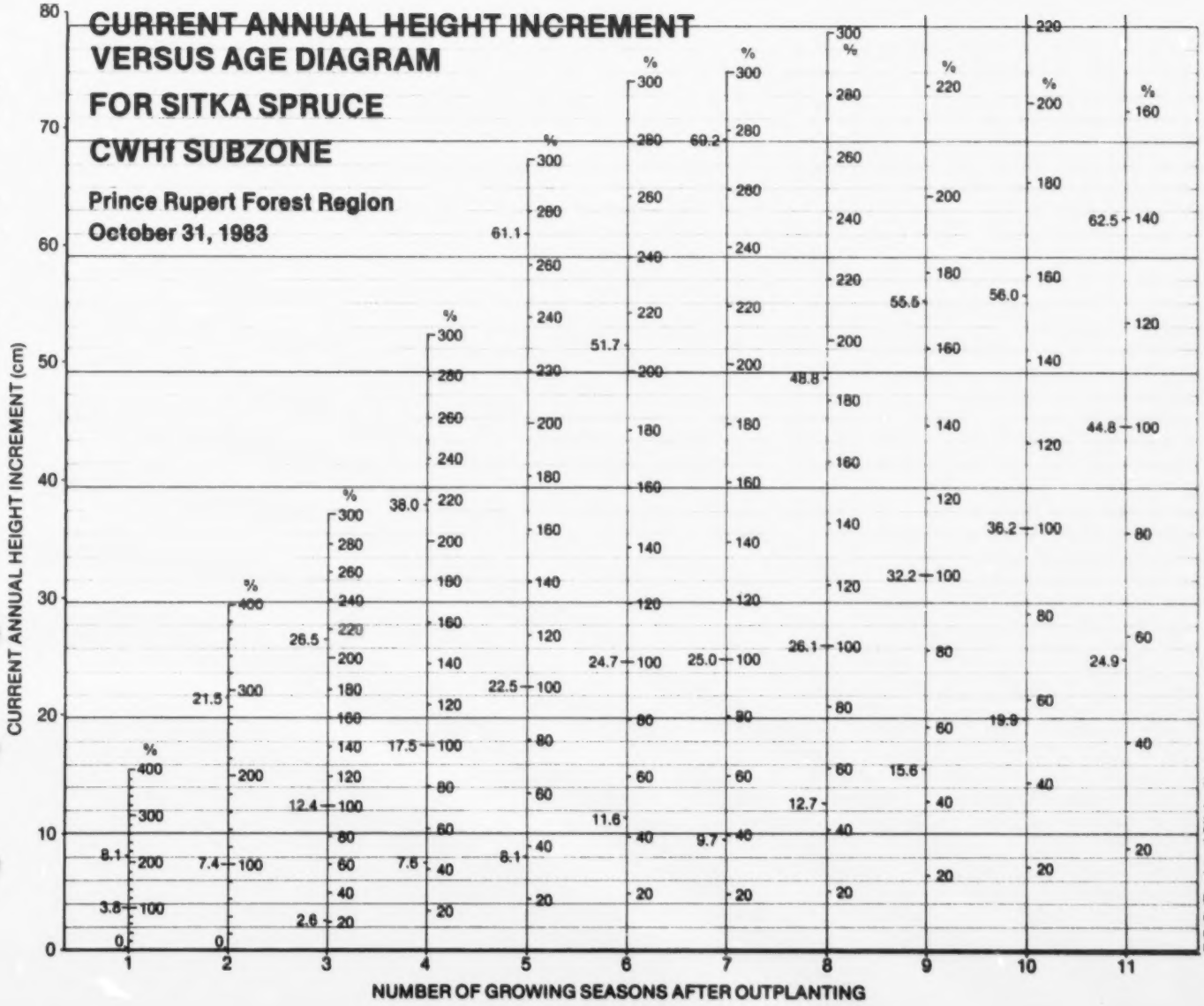

HEIGHT VERSUS AGE DIAGRAM
FOR HYBRID SPRUCE
ICHg SUBZONE
Prince Rupert Forest Region
January 31, 1984
HEIGHT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
F.R.O./Regional Silviculture


HEIGHT VERSUS AGE DIAGRAM
FOR LODGEPOLE PINE
ICHg SUBZONE
Prince Rupert Forest Region
January 31, 1984
HEIGHT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
*less than 6 observations
F.R.O./Regional Silviculture

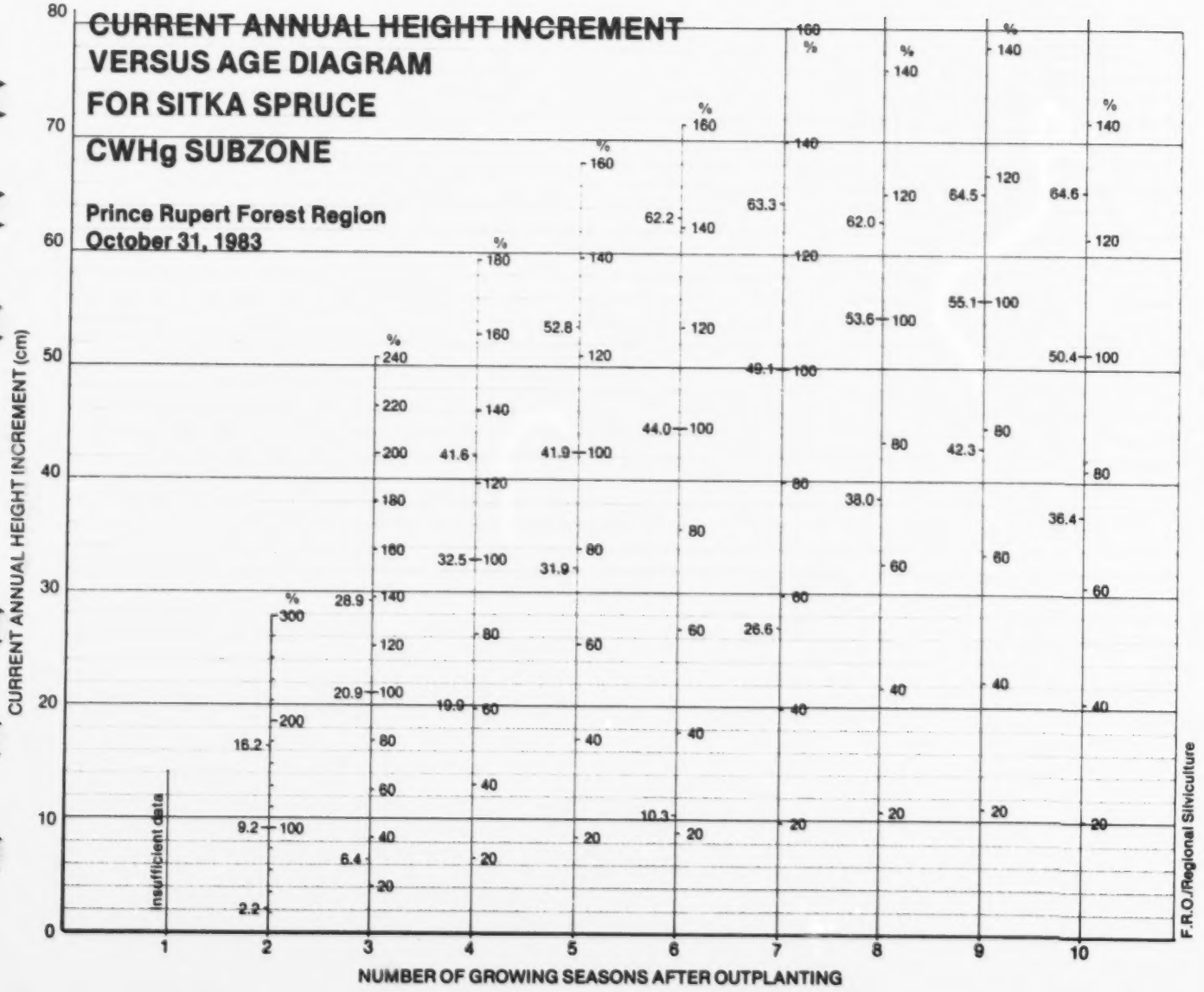

HEIGHT VERSUS AGE DIAGRAM
FOR LODGEPOLE PINE
SBSe SUBZONE
Prince Rupert Forest Region
June 30, 1983
HEIGHT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
F.R.O./Regional Silviculture

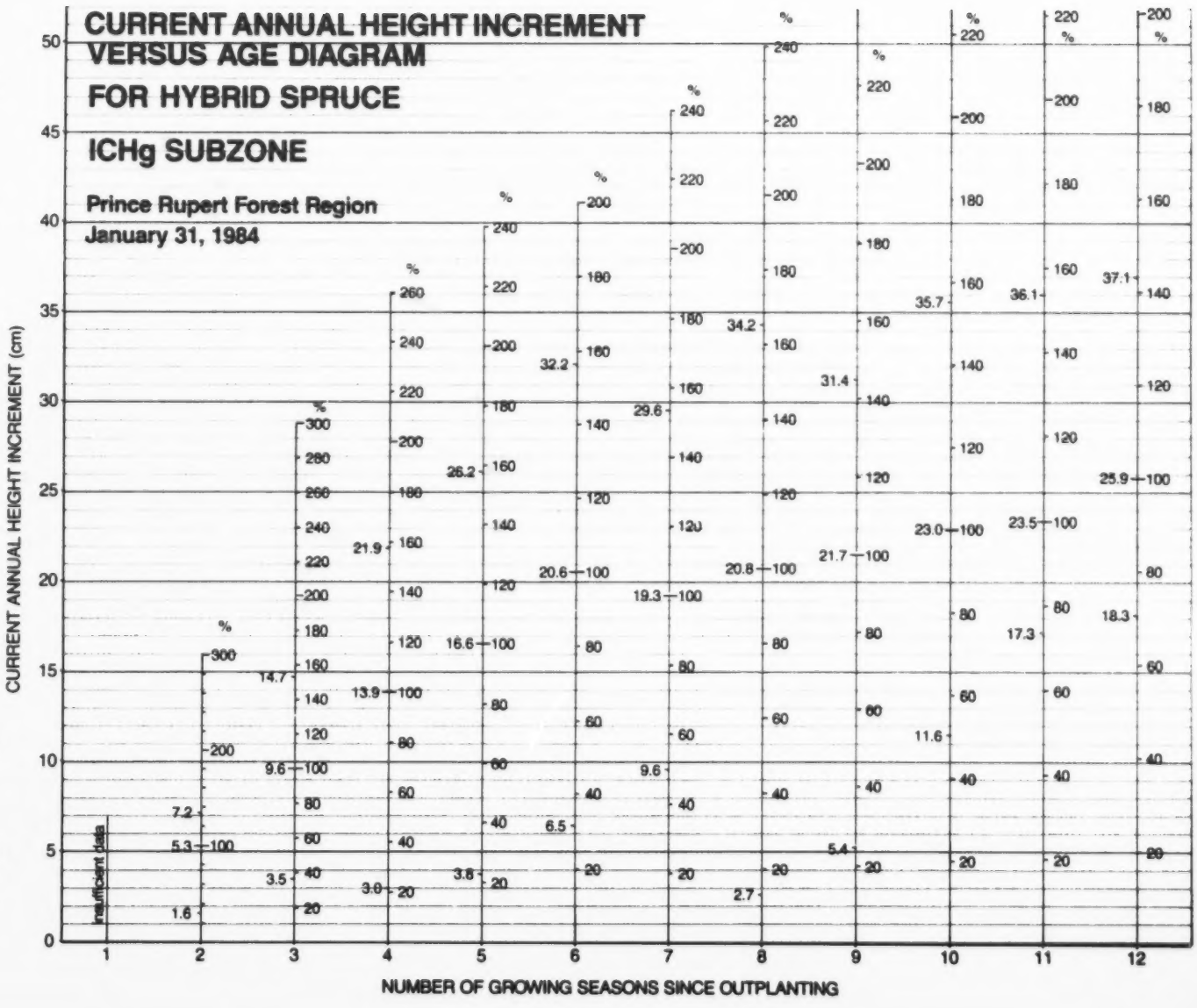
CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR SITKA SPRUCE CWHf SUBZONE

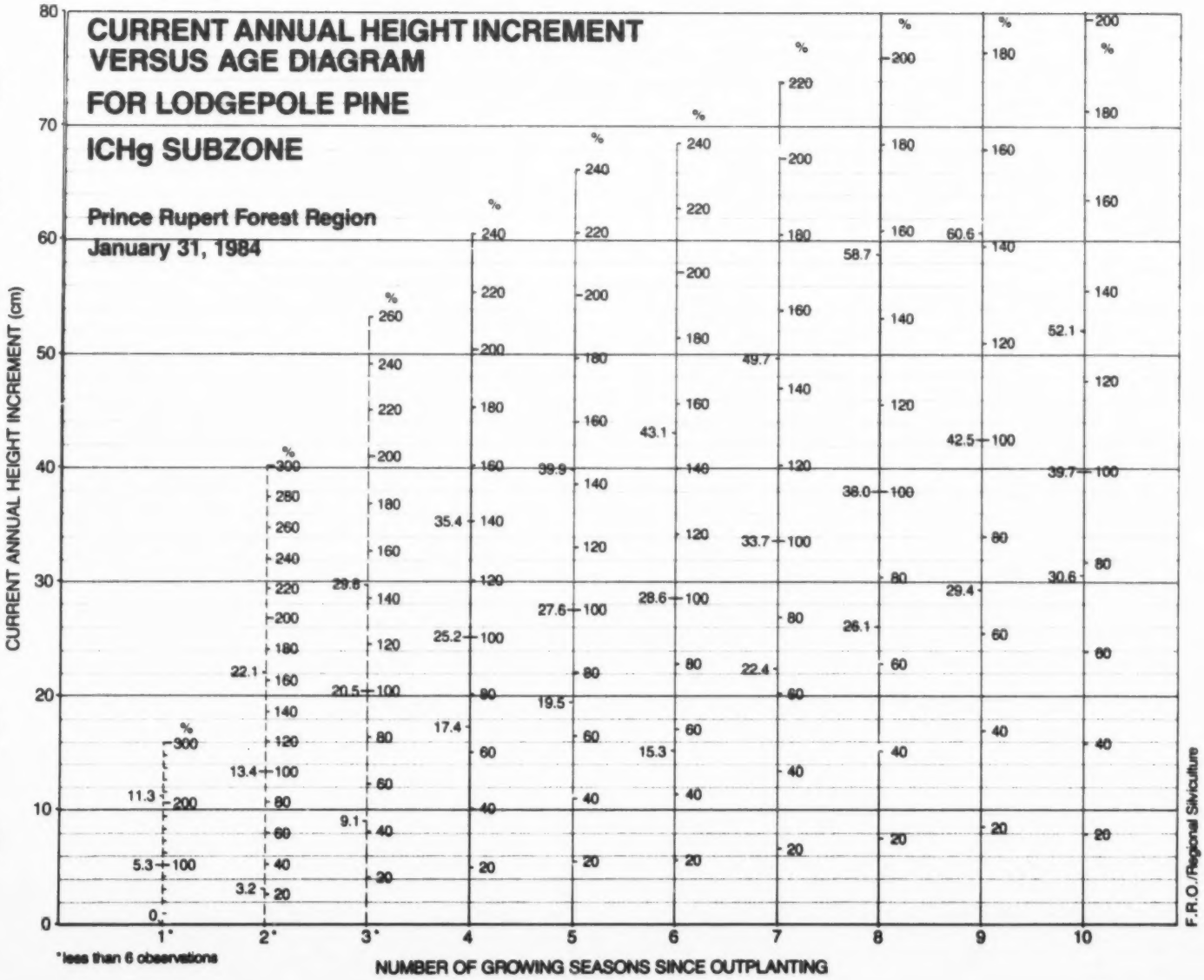
Prince Rupert Forest Region
October 31, 1983



F.R.O./Regional Silviculture


CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR SITKA SPRUCE CWHg SUBZONE
Prince Rupert Forest Region
October 31, 1983
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS AFTER OUTPLANTING
Insufficient data
F.R.O./Regional Silviculture

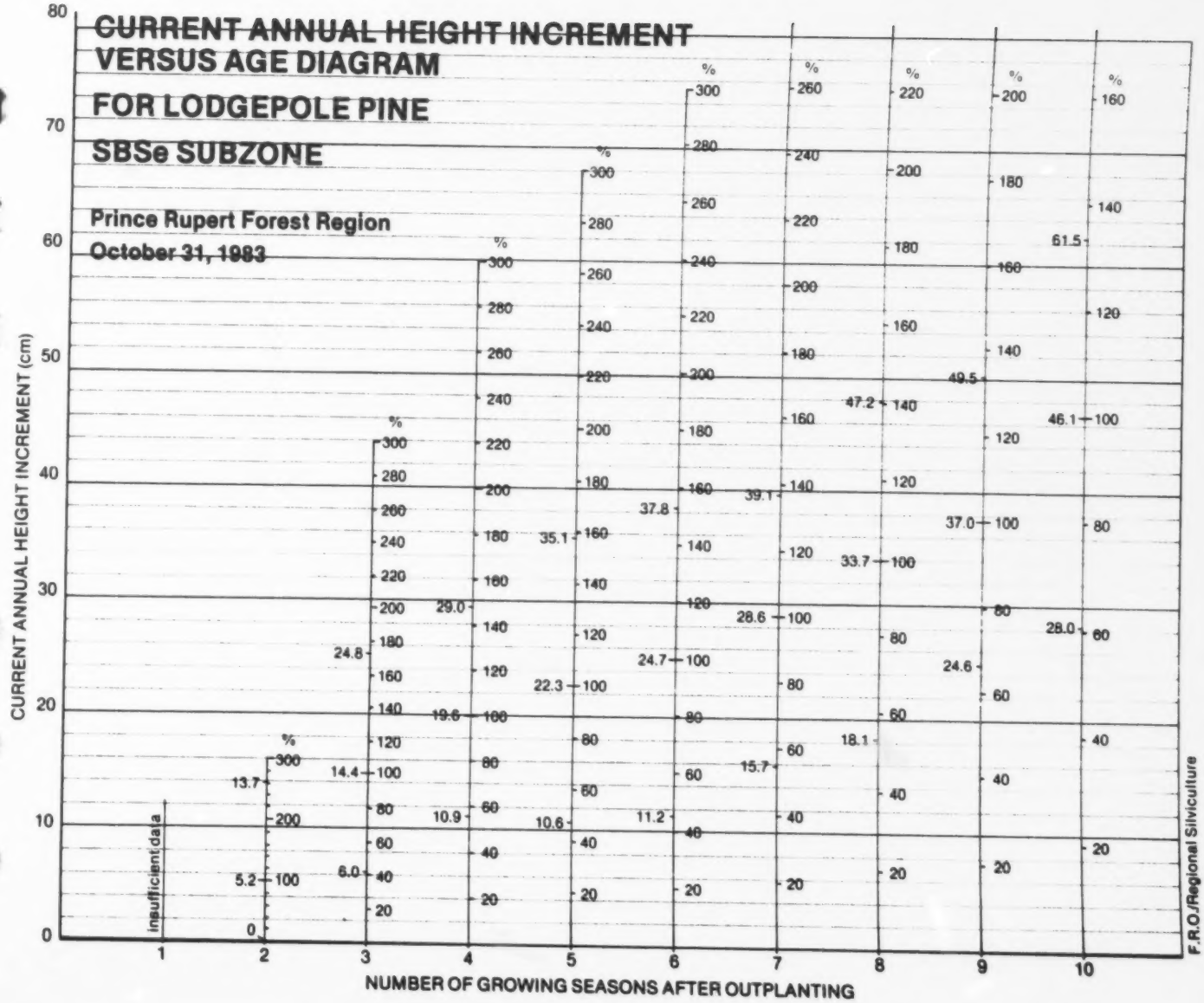

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR HYBRID SPRUCE
ICHg SUBZONE
Prince Rupert Forest Region
January 31, 1984
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
Insufficient data


CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM
FOR LODGEPOLE PINE
ICHg SUBZONE
Prince Rupert Forest Region
January 31, 1984
CURRENT ANNUAL HEIGHT INCREMENT (cm)
NUMBER OF GROWING SEASONS SINCE OUTPLANTING
*less than 6 observations
F.R.O./Regional Silviculture

CURRENT ANNUAL HEIGHT INCREMENT VERSUS AGE DIAGRAM FOR LODGEPOLE PINE SBSe SUBZONE

Prince Rupert Forest Region

October 31, 1983



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